

Schedule Summer School Randomness in Physics & Mathematics

(week 1 = 12. - 17. August 2019 & week 2 = 19. - 24. August 2019)

week 1	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9:15	welcome					
9:30-10:30	Knowles	Kühn	Kuijlaars	Panchenko	Knowles	Kuijlaars
coffee						
11-12	Kuijlaars	Panchenko	Kühn	Knowles	Kuijlaars	Kühn
lunch 12:30						12:15 excursion:
14-15	Panchenko	Knowles	talks*	Kühn	Panchenko	→ Externsteine
15-16:30	exercises	exercises	coffee* &	exercises	solutions	→ Velmerstot
coffee			talks*			
17-18	solutions	solutions		solutions	exercises	→Silbermühle
18:30	concert					with diner 18:00
	barbeque				solutions	

week 2	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9:30-10:30	Virág	Serfaty	Serfaty	Sodin	Spohn	Sodin
coffee						
11-12	Sodin	Virág	Spohn	Spohn	Sodin	Virág
lunch 12:30						
14-15	Serfaty	Serfaty	talks*	Virág	Spohn	departure
15-16:30	exercises	exercises	coffee* &	exercises	exercises	
coffee			poster*			
17-18	solutions	solutions	talks*	solutions	solutions	
18:30	"visible music"					
	barbeque					

* see separate Wednesday afternoon's programme

Lecture titles week 1:

- Antti Knowles: Nonbacktracking matrices, tridiagonal matrices, and applications to the extremal eigenvalues of random graphs
- Arno Kuijlars: From Jacobi polynomials to tilings of a hexagon
- Dmitry Panchenko: Ultrametricity in the Sherrington-Kirkpatrick model
- Reimer Kühn: Stochastic Processes on Complex Networks

concert: Markus Schwartze (piano) and Willem Schulz (cello)

Lecture titles week 2:

- Bálint Virág: Random interfaces, geodesics and the directed landscape
- Sasha Sodin: Some aspects of the one-dimensional Anderson model
- Sylvia Serfaty: Statistical mechanics of Coulomb gases
- Herbert Spohn: Hydrodynamics of the classical Toda chain and random matrix theory

concert "visible music": Markus Schwartz and the Institute for Pulsar Phonology (Angelika Höger, Lucie Marsmann)

Abstracts/Literature/Recommendations for the lectures:

- Dmitry Panchenko:
<https://www.youtube.com/watch?v=RCHQqaZVfT4&feature=youtu.be>
<https://www.youtube.com/watch?v=iDWMMqknWyE&feature=youtu.be>
The Sherrington-Kirkpatrick model, Springer, available upon request - It would be useful to review Section 1.2 before the lectures.
- Sylvia Serfaty: Large ensembles of points with Coulomb type interactions arise in various settings of condensed matter physics, classical and quantum mechanics, statistical mechanics, random matrices and even approximation theory, We study the Gibbs measure associated to such systems in general dimension. We discuss the free energy expansion as well as a description of the microscopic behavior of the system as N tends to infinity via a Large Deviations Principle and a Central Limit Theorem for fluctuations. This allows for instance to observe the effect of the temperature and to connect with crystallization questions. We will give an idea of tools and methods used to prove the results, in particular the introduction of the "electric formulation".
- Herbert Spohn: There has been a lot of interest, mostly on the quantum side, to develop the hydrodynamics of integrable systems, thus involving an infinite number of conservation laws. Surprisingly a model-independent structure is claimed, except for the specific two-particle phase shift. I will use the classical Toda chain as a road map for the general picture. The Toda chain has a tridiagonal Lax matrix, which under the generalised Gibbs ensemble becomes random. The corresponding density of states can be determined through a tricky use of the Dumitriu-Edelman theorem. Also a connection to Dyson's Brownian motion will be discussed.

- Bálint Virág: Coastlines, the edge of burned paper, the boundary of coffee spots, the game of Tetris: random interfaces surround us. Still, the mathematical theory of one of the the most important cases, the "KPZ universality class", has only been cracked very recently.

This class is related to traffic models, longest increasing subsequences of random permutations, the RSK correspondence, last passage percolation, integrable probability systems and the stochastic heat equation. A new random metric in the plane, the "directed landscape" captures the essence of these problems.

<https://arxiv.org/abs/1812.00309>

- Sasha Sodin: It is recommended to revisit basic operator theory, e.g. notions of spectrum, essential spectrum incl. Weyl's criterion, spectral radius incl. Gelfand's formula

Wednesday Afternoon's Programme

Wednesday 14.8.		Wednesday 21.8.	
14:00 – 14:15	Anas Rahman	14:00 – 14:15	Seong-Mi Seo
14:15 – 14:30	Daria Tieplova	14:15 – 14:30	Sungsoo Byun
14:30 – 14:45	Ana Gusakova	14:30 – 14:45	Ivan Parra
14:45 – 15:00	Oleksandr Minakov	14:45 – 15:45	coffee &
15:00 – 15:30	coffee		poster session
15:30 – 15:45	Ekatarina Shchetka	15:45 – 16:00	Ievgenii Afanasiev
15:45 – 16:00	Noela Müller	16:00 – 16:15	Juan G. Criado del Rey
16:00 – 16:15	Mariia Platonova	16:15 – 16:30	Adam Mielke
16:15 – 16:30	break	16:30 – 16:45	break
16:30 – 16:45	Shi-Hao Li	16:45 – 17:00	Mohamed Slim Kammoun
16:45 – 17:00	Harini Desiraju	17:00 – 17:15	Leslie Diëgo Molag
17:00 – 17:15	Renjie Feng	17:15 – 17:30	Giorgio Cipollini

Poster Titles:

- Andrew Celsus: *Supercritical Regime for the Kissing Polynomials*
- Michael Clark: *Edge Distribution of a 1D Bose Gas*
- Jonas Jalowy: *Rate of convergence to the circular law and its products*
- Yulia Petrova: *Exact L_2 -small ball asymptotics for detrended Green Gaussian processes*
- Allan Kaching Trinh: *Finite size corrections at the hard edge for the Laguerre β -ensemble*
- Meng Yang: *Planar orthogonal polynomials with logarithmic singularities in the external potential*
- Jiyuan Zhang: *The rank one randomised Horn's problem*

Talk Titles:

- Ievgenii Afanasiev: *On the Correlation Functions of the Characteristic Polynomials of the Non-Hermitian Random Matrices with Independent Entries*
- Sungsoo Byun: *The interface between Hermitian and normal eigenvalue ensembles*
- Giorgio Cipolloni: *Edge Universality for non-Hermitian Random Matrices*
- Juan G. Criado del Rey: *it Spherical ensemble with two charges*
- Harini Desiraju: *Painlevé II tau-function as a Fredholm determinant*
- Renjie Feng: *Extreme gap problems for classical random matrices*
- Anna Gusakova: *Distribution of Salem numbers and their connection to the eigenvalues of Jacobi β -ensemble*
- Mohamed Slim Kammoun: *Universality for random permutations*
- Shi-Hao Li: *Discrete skew orthogonal polynomials related to discrete symplectic ensemble*
- Adam Mielke: *Bulk Universality in Ginibre Ensembles and Applications to Quantum Chaos*
- Oleksandr Minakov: *Unbounded solutions of the Korteweg-de-Vries equation via inverse scattering transform method*
- Leslie Diëgo Molag: *The local universality of Muttalib-Borodin bi-orthogonal ensembles*
- Noela Müller: *The replica symmetric phase of random constraint satisfaction problems*
- Ivan Parra: *Local correlations of two-dimensional Coulomb gases on an ellipse*
- Mariia Platonova: *On branching random walks on periodic lattices*
- Anas Rahman: *Eigenvalue Densities of Classical Matrix Ensembles*
- Seong-Mi Seo: *A scale of boundary conditions for the random normal matrix model*
- Ekaterina Shchetka: *On the integrated density of states of the Harper operator*
- Daria Tieplova: *On the behaviour of the singular values of empirical autocovariance matrices in the high-dimensional*