Workshop on interacting particle systems and random matrices

Simons Semester in Probability and Statistical Physics, Erdős Center Budapest, 23-27 June, 2025

Program

Monday, 23rd June

08:15–09:00 *Registration*

09:00–09:35 Timo Seppäläinen
Busemann functions in directed polymers

09:40–10:15 Christopher Janjigian
Infinite geodesics in inhomogeneous exponential last passage percolation

10:15–10:45 *Coffee*

10:45–11:20 Van Vu
Eigenvalues under random perturbation

11:25–12:00 Alessandra Occelli
Discrete and continuous Muttalib–Borodin ensemble: hard edge fluctuations and large deviations

12:00–14:00 *Lunch break*

14:00–14:35 Riddhipratim Basu
Improved variance bounds in rotationally invariant first passage percolation

14:40–15:15 Erik Bates
Balanced multi-species spin glasses

15:15–15:45 *Coffee*

15:45–16:20 Thomas Bothner
Complex moments for characteristic polynomials in the circular unitary ensemble

16:25–17:00 Theo Assiotis
Joint moments of characteristic polynomials of random matrices from the classical compact groups

17:20–18:10 Short talks:

17:20 Victor Ginsburg
Critical last passage percolation

17:32 Kiran Kumar
Random Simplicial Complexes in thermodynamic regime

17:44 Kailun Chen
Appications of random walks on hecke algebras

17:56 Arvind Ayyer
GOE fluctuations in Alternating Sign Matrices

18:30–20:00 *Wine reception*

Tuesday, 24th June

09:00–09:35 Bálint Vető
The Brownian web distance

09:40–10:15 Emma Bailey
Conditional large deviations of Selberg's CLT

10:15–10:45 *Coffee*

10:45–11:20 Joseph Najnudel
The Fourier coefficients of the holomorphic multiplicative chaos

11:25–12:00 Gaultier Lambert
Fluctuations for a class of two-dimensional determinantal point processes

12:00–14:00 *Lunch break*

14:00–14:35 Brian Rider
Some solvable families of random block tridiagonals

14:40–15:15 Neil O'Connell
Discrete Whittaker processes

15:15–15:45 *Coffee*

15:45–16:20 Mustazee Rahman
Some reflections on Skorokhod reflection

16:40–17:30 Short talks:

16:40 Thomas Buc-d'Alché
Topological expansion of unitary integrals and maps

16:52 Yang Chu
Multi-players Tug-of-war and exclusion processes

17:04 Gabriel Raposo
Fluctuations for Standard Young Tableaux via $2d$ Gaussian fields

17:16 Angeliki Koutsimpela
Tagged particles and size-biased dynamics in mean-field interacting particle systems

17:45–18:35 Short talks:

17:45 Yahui Qu
Pair correlation function for Sine-beta process

17:57 Kartick Adhikari
Local weak limit of sparse random uniform hypegraphs

18:09 Sam McKeown
An FPP model for minimal train journey costs

18:21 Ella Hiesmayr
The Spectral Edge of Constant Degree Erdős-Rényi Graphs

Wednesday, 25th June

09:00–09:35 Milène Maïda
$2d$ Yang-Mills theory on the torus: stochastic, combinatorial and topological aspects

09:40–10:15 Lingfu Zhang
Half-Space Stationary Horizon

10:15–10:45 *Coffee*

10:45–11:20 James Martin
Interchangeability of rates in interacting particle systems and last-passage percolation

11:25–12:00 Evan Sorensen
Viscous shock fluctuations in KPZ

Thursday, 26th June

09:00–09:35 Patrik Ferrari
Decoupling and decay of two-point functions in a two-species TASEP

09:40–10:15 Peter Nejjar
Limit profiles of ASEP

10:15–10:45 *Coffee*

10:45–11:20 Dominik Schmid
Mixing times for the open ASEP

11:25–12:00 Pierre Le Doussal
Exact results for the macroscopic fluctuation theory of the weakly asymmetric process

12:00–14:00 *Lunch break*

14:00–14:35 Vadim Gorin
The Airy-beta line ensemble

14:40–15:15 Yun Li
Limits of the truncated circular beta ensembles

15:15–15:45 *Coffee*

15:45–16:20 Nick Simm
Large deviation probabilities in geometric last passage percolation

16:25–17:15 Short talks:

16:25 Martin Malvy
Long-range correlations for the Sine beta process

16:37 Sudeshna Bhattacharjee
Law of fractional logarithm for the GUE minor process

16:49 Vlad Margarint
A bridge between Random Matrix Theory and Schramm-Loewner Evolutions Theory

17:01 Kateryna Hlyniana
Gaussian Structure in Coalescing Stochastic Flows

17:30–18:05 Shirshendu Ganguly (online)
Critical last passage percolation

18:10–18:45 Short talks:

18:10 Sabrina Gernholt
TASEP with a moving wall and generic initial conditions

18:22 Panagiotis Zografos
Domino tilings of the Aztec diamond in random environment

18:34 Helene Götz
Nonstandard Large and Moderate Deviations for the Laguerre Ensemble

Friday, 27th June

09:00–09:35 Patrícia Gonçalves
Discussion on the universality of some multi-component systems

09:40–10:15 Reda Chhaibi
Matsutomo-Yor processes on Jordan algebras

10:15–10:45 *Coffee*

10:45–11:20 Philippe Sosoe
Regularity conditions in CLT for linear statistics of random matrices

11:25–12:00 Thomas Leblé

Gradient flow of the infinite-volume free energy for short-range lattice systems of continuous spins

Abstracts of Talks

Theo Assiotis (University of Edinburgh):
Joint moments of characteristic polynomials of random matrices from the classical compact groups
Mon 16:25

I will talk about the problem of computing the asymptotics of joint moments of characteristic polynomials, with any number and order of derivatives, of random matrices drawn from the classical compact groups (unitary, symplectic, orthogonal). There are some interesting connections with exchangeable arrays and integrable systems. These asymptotics give conjectures in number theory for the Riemann zeta function, Hardy's function and certain families of L-functions.

This is based on joint work, some ongoing, with Alper Gunes, Jon Keating and Fei Wei.

Emma Bailey (University of Bristol):
Conditional large deviations of Selberg's CLT
Tue 09:40

The logarithm of the characteristic polynomial of a randomly drawn unitary matrix, suitably normalised, satisfies a central limit theorem. Both large deviation principles and precise statements have been established for this random variable. An analogous central limit theorem holds for the logarithm Riemann zeta function on the critical line, whilst asymptotics of its exponential moments (moments of $\zeta(1/2+it)$) remain a topic of study. We prove bounds on its deviation probability, partly conditional on the Riemann hypothesis. A consequence of this result is the sharp bounds on the moments of $\zeta(1/2+it)$, established by Harper and by Soundararajan.

Riddhipratim Basu (ICTS-TIFR Bengaluru):
Improved variance bounds in rotationally invariant first passage percolation
Mon 14:00

For certain rotationally invariant models of planar first passage percolation, we use a multi-scale argument to show that the variance grows with an exponent strictly smaller than 1, providing a polynomial improvement to previously known bounds. Our argument proceeds via establishing that the geodesic is chaotic at multiple scales, i.e., after resampling a small fraction of the underlying randomness, the expected fraction of overlap between the updated geodesic and the original one is small. This is based on joint work with Vladas Sidoravicius and Allan Sly.

Erik Bates (North Carolina State University):
Balanced multi-species spin glasses
Mon 14:40

Spin glasses were originally conceived as a mean-field description for disordered magnetism, and have since become a mathematical prototype for frustrated disordered systems and high-complexity functions. Their spherical versions have also profited from connections to random matrix theory. In recent years, the theory for multi-type spin glasses has been developing with many successful advancements, although naturally the story is murkier and more complicated than for classical spin glasses. I will describe a special case of these generalized models for which the storyline has a satisfying shortcut. Based on joint work with Youngtak Sohn.

Thomas Bothner (University of Bristol):
Complex moments for characteristic polynomials in the circular unitary ensemble
Mon 15:45

We compute joint moments of the characteristic polynomial and its derivative of a $N \times N$ unitary matrix drawn from the CUE in the case that the exponents in the moments are complex-valued. The calculation is performed for finite matrix size and in the limit $N \to \infty$. Based on ongoing joint work with Fei Wei (Sussex).

Reda Chhaibi (Université Côte d'Azur):
Matsutomo-Yor processes on Jordan algebras
Fri 09:40

This talk is about the interplay between:

- the geometric $2M-X$ Matsumoto-Yor process, which enjoys the Markov property. Its relevance for this conference, is that it basically is equivalent to a Brownian directed polymer model with two lines.
- Jordan algebras, studied by Jordan, Von Neumann and Wigner for physical reasons.

We provide a generalization of the Matsumoto-Yor process to the context of Jordan algebras, and we prove the Markov property for this generalization. Our Markov process occurs as a limit of discrete-time $AX + B$ Markov chains on the cone of squares whose invariant probability measures classically provide a Dufresne-type identity for a perpetuity. In particular, the paper provides a generalization to any symmetric cone of the initial matrix generalization of the Matsumoto-Yor process and Dufresne identity by Rider-Valkó.
Joint work with Manon Defosseux.

Patrik Ferrari (Universität Bonn):
Decoupling and decay of two-point functions in a two-species TASEP
Thu 09:00

We consider the two-species totally asymmetric simple exclusion process on $\mathbb{Z}$ with a translation-invariant stationary measure as the initial condition. We establish the asymptotic decoupling of the marginal height profiles along characteristic lines and prove the decay of the two-point functions in the large-time limit, thus confirming predictions of the nonlinear fluctuating hydrodynamics theory.

Shirshendu Ganguly (UC Berkeley):
Critical last passage percolation
Thu 17:30

Last passage percolation (LPP) is a model of random geometry where the main observable is a directed path evolving in a random environment. When the environment distribution has light tails and a fast decay of correlation, the random fluctuations of LPP are predicted to be explained by the Kardar-Parisi-Zhang (KPZ) universality theory. However, the KPZ theory is not expected to apply in many natural settings, such as "critical" environments exhibiting a hierarchical, fractal-like structure which should give rise to a fluctuation theory featuring logarithmic corrections with novel critical exponents. Predictions for these exponents are missing, even from the physics literature.

In recent joint work with Victor Ginsburg and Kyeongsik Nam we initiated the study of LPP in hierarchical environments, developing a framework based on multi-scale analysis and obtaining bounds on critical exponents for two canonical examples: an i.i.d. environment with critical power-law tails, and a hierarchical approximation of the two-dimensional Gaussian Free Field. This will be a two part talk. In the first short talk, Victor will describe these models and formulate our results. We will continue this discussion, giving a more comprehensive overview of our work and touching upon ongoing work with Kaihao Jing exploring connections to fractal percolation as well as related polymer models.

Patrícia Gonçalves (Instituto Superior Técnico, Lisboa):
Discussion on the universality of some multi-component systems
Fri 09:00

In the seventies, Frank Spitzer introduced interacting particle systems (IPS) to the mathematics community. These systems consist of particles evolving randomly according to Markovian dynamics that conserve certain quantities. One of the most classical IPS is the exclusion process, where particles evolve in a discrete space according to a transition probability, but at each site, only one particle is allowed. One of the goals of studying these models is to derive their hydrodynamic limit, i.e., to deduce the macroscopic equations governing the space-time evolution of the conserved quantities of the system from the underlying random motion of the microscopic particles, as well as the fluctuations around the hydrodynamic limit.

In this talk, I will review the equilibrium fluctuations, i.e., the fluctuations starting from the invariant measure for exclusion processes. Our focus will then shift to the multi-component case, ie an exclusion with two conservation laws and for proper linear combinations of the conserved quantities, their evolution is autonomous and either given by Ornstein-Uhlenbeck processes or energy solutions to the Stochastic Burgers equation. Finally I will also discuss fractional limits for interface models and discuss open problems based on mode coupling predictions.

This presentation is based on joint work with G. Cannizzaro, R. Misturini, and A. Occelli.

Vadim Gorin (UC Berkeley):
The Airy-beta line ensemble
Thu 14:00

Beta-ensembles generalize the eigenvalue distributions of self-adjoint real, complex, and quaternion matrices for $\beta = 1, 2$, and 4, respectively. These ensembles naturally extend to two dimensions by introducing operations such as corner truncation, addition, or multiplication of matrices. In this talk, we will explore the edge asymptotics of the resulting two-dimensional ensembles. I will present the Airy-beta line ensemble, a universal object that governs the asymptotics of time-evolving largest eigenvalues. This ensemble consists of an infinite collection of continuous random curves, parameterized by beta. I will share recent progress in developing a framework to describe this remarkable structure.

Christopher Janjigian (Purdue University):
Infinite geodesics in inhomogeneous exponential last passage percolation
Mon 09:40

This talk will discuss some recent progress on understanding the structure of semi-infinite geodesics and their associated Busemann functions in the inhomogeneous exactly solvable exponential last-passage percolation model. In contrast to the homogeneous model, this generalization admits linear segments of the limit shape and an associated richer structure of semi-infinite geodesic behaviors. Depending on certain choices of the inhomogeneity parameters, we show that the model exhibits new behaviors of semi-infinite geodesics, which include wandering semi-infinite geodesics with no asymptotic direction, isolated asymptotic directions of semi-infinite geodesics, and non-trivial intervals of directions with no semi-infinite geodesics.

Gaultier Lambert (KTH Stockholm):
Fluctuations for a class of two-dimensional determinantal point processes
Tue 11:25

I will introduce a family of two-dimensional determinantal point processes which generalize the Ginibre ensemble. These processes arise by considering the ground state of free fermions subject to a magnetic Schrödinger operator when the magnetic field is large. I will present a central limit theorem for linear statistics of such ensembles in the infinite number of particle limit. Like for the Ginibre ensemble, the fluctuations are of order one and there are contributions from both the bulk and boundary of the droplet. In contrast to the Ginibre ensemble, for anisotropic droplets, the contribution of the boundary is not conformally invariant. The proof relies on semiclassical method and the strong Szegő limit theorem. If I have time, I will mention analogous results for one-dimensional free fermions. Joint work with Alix Deleporte (Université Paris-Saclay).

Pierre Le Doussal (ENS Paris):
Exact results for the macroscopic fluctuation theory of the weakly asymmetric process
Thu 11:25

Thomas Leblé (Université de Paris-Cité):
Gradient flow of the infinite-volume free energy for short-range lattice systems of continuous spins
Fri 11:25

We construct the gradient flow for the free energy of an infinite system of continuous spins, following an infinite-volume adaptation of the JKO scheme. We prove that trajectories of the gradient flow and those obtained from overdamped Langevin dynamics satisfy the same infinite-volume Fokker-Planck equations. We derive an Evolution Variational Inequality, proving uniqueness of solutions and thus that the trajectories coincide. If the spin state has positive curvature, and at high enough temperature, we obtain exponential convergence to equilibrium.

Joint work with Ronan Herry (Rennes).

Yun Li (Tsinghua University, Beijing):
Limits of the truncated circular beta ensembles
Thu 14:40

Consider a Haar unitary matrix with the first row and column deleted, Życzkowski and Sommers derived the joint distribution of the eigenvalues, and showed that they form a determinantal point process. Killip and Kozhan extended this result to circular beta ensembles, and provided a description of the spectrum of the truncated version of the circular beta ensembles. In this talk, I will discuss the bulk and edge point process limits of the truncated circular beta ensembles, along with the scaling limits of the normalized characteristic polynomials. The limiting objects are closely connected to the iid Gaussian power series and the stochastic zeta function, in the bulk and edge regimes, respectively. Based on joint works with Mingchang Liu, Joseph Najnudel, and Benedek Valkó.

Milène Maïda (Université de Lille):
2d Yang-Mills theory on the torus: stochastic, combinatorial and topological aspects
Wed 09:00

Getting expansions for matrix integrals is an active topic within random matrix theory. When the coefficients of the expansions are related to geometrical or topological invariants, these expansions are called topological expansions. It is in general hard to show that topological expansions are not only formal power series but that they are convergent. In this talk, we will address this problem for a model of random unitary matrices that happens to be the partition function of the two-dimensional Yang-Mills theory with gauge group $U(N)$. When the underlying surface is a torus, we have a full description of the topological expansion, show that it is related to the enumeration of ramified coverings of the torus and establish rigorously a string/gauge duality result predicted by Gross and Taylor in the nineties. This is joint work with Thibaut Lemoine (Collège de France)

James Martin (University of Oxford):
Interchangeability of rates in interacting particle systems and last-passage percolation
Wed 10:45

There are many examples of inhomogeneous exactly interacting particle systems (or queueing networks, percolation models...) with interesting invariance properties under permutation of their rates. I will describe some old and new results and some applications.

Joseph Najnudel (University of Bristol):
The Fourier coefficients of the holomorphic multiplicative chaos
Tue 10:45

In this talk, we consider the coefficients of the Fourier series obtained by exponentiating a logarithmically correlated holomorphic function on the open unit disc, whose Taylor coefficients are independent complex Gaussian variables, the variance of the coefficient of degree k being θ/k where $\theta > 0$ is an inverse temperature parameter. In joint articles with Paquette, Simm and Vu, we show a randomized version of the central limit theorem in the subcritical phase $\theta < 1$, the random variance being related to the Gaussian multiplicative chaos on the unit circle. We also deduce, from results on the holomorphic multiplicative chaos, other results on the coefficients of the characteristic polynomial of the Circular Beta Ensemble, where the parameter β is equal to $2/\theta$. In particular, we show that the central coefficient of the characteristic polynomial of the Circular Unitary Ensembles tends to zero in probability, answering a question asked in an article by Diaconis and Gamburd.

Peter Nejjar (Potsdam University):
Limit profiles of ASEP
Thu 09:40

The ASEP on the segment is known to exhibit the cutoff phenomenon, an abrupt convergence to equilibrium. We obtain the limiting profile describing the cutoff in certain cases.

Alessandra Occelli (Université d'Angers):
Discrete and continuous Muttalib–Borodin ensemble: hard edge fluctuations and large deviations
Mon 11:25

I will present probabilistic and combinatorial aspects of natural volume- and trace-weighted plane partitions and their continuous analogues; discuss limit laws for the largest parts of these ensembles in terms of hard- and soft-edge distributions of random matrix theory, showing an interpolating behaviour between the Gumbel and the GUE Tracy-Widom distribution for a certain choice of the parameters involved; present a large deviation principle for the empirical measure of the plane partition and characterise its equilibrium measure in certain regimes, obtained via a Riemann-Hilbert problem associated to the minimisation problem of the rate function. Based on joint works with D. Betea, J. Husson and G. Mazzuca.

Neil O'Connell (UC Dublin):
Discrete Whittaker processes
Tue 14:40

I will discuss a Markov chain on reverse plane partitions (of a given shape) which is closely related to the Toda lattice. This process has non-trivial Markovian projections and a unique entrance law starting from the reverse plane partition with all entries equal to plus infinity. I will also outline some connections with imaginary exponential functionals of Brownian motion, a random polymer model with purely imaginary disorder, interacting corner growth processes and discrete delta-Bose gas, and hitting probabilities for some low rank examples.

Mustazee Rahman (Durham University):
Some reflections on Skorokhod reflection
Tue 15:45

I will present some determinantal formulas for a model of Brownian last passage percolation with a boundary. For a single Brownian motion, it becomes a formula for the reflection of a Brownian motion off a deterministic function. This model, and the formulas, are related to the tasep particle system where the leading particle has a deterministic trajectory.

Brian Rider (Temple University):
Some solvable families of random block tridiagonals
Tue 14:00

The tridiagonal matrix models for the Gaussian beta-ensembles of Dumitriu-Edelman have been the launching point for a huge number of results over the last many years. Here we explore their original approach in the block setting, and obtain two families of random tridiagonal block models for which the joint eigenvalue distribution can be computed explicitly. The "random operator approach" then allows us to establish point process limits of the corresponding eigenvalues at the edge(s). Along the way, we discover certain algebraic identities involving Vandermonde determinants which could be of independent interest. Joint work with Benedek Valkó.

Dominik Schmid (University of Augsburg):
Mixing times for the open ASEP
Thu 10:45

In this talk, we consider the asymmetric simple exclusion process with open boundaries (open ASEP). We give an overview on recent results on mixing times for the open ASEP. In particular, we discuss mixing times for the open ASEP at the triple point. This talk is based on joint work with Patrik Ferrari.

Timo Seppäläinen (UW-Madison):
Busemann functions in directed polymers
Mon 09:00

This talk is a brief overview of recent progress in the study of planar directed polymer models through their Busemann functions. We describe the distribution of the Busemann process of the inverse-gamma polymer and present results that can be derived from this knowledge: multiplicity of polymer Gibbs measures, nonexistence of bi-infinite polymer paths, and coalescence exponents. Based on joint projects with Erik Bates (NC State), Ofer Busani (Edinburgh), Louis Fan (Chapel Hill), Firas Rassoul-Agha (Utah), and Xiao Shen (NC State).

Nick Simm (University of Sussex):
Large deviation probabilities in geometric last passage percolation
Thu 15:45

In this talk I will discuss large deviation probabilities for geometric last passage percolation. In this model, all sites of the integer lattice are populated by i.i.d. geometric random variables with a given parameter. Our interest is in the last passage time, i.e. the maximal sum over all possible up-right paths to a given target site of the lattice. We build on a famous work of Johansson who established the leading term of the large deviations and convergence to the Tracy-Widom distribution. By exploring further the connection with random matrix theory, we show how it is possible to extract explicit formulas for both lower and upper tail rate functions, including expressions for the first 3 sub-leading corrections in the form of an asymptotic expansion. Our approach is based on certain random matrix identities, linking the percolation problem with distributions from random matrix theory and with the free energy of a two dimensional Coulomb gas. This is joint work with Sungsoo Byun, Christophe Charlier and Philippe Moreillon.

Evan Sorensen (Columbia University):
Viscous shock fluctuations in KPZ
Wed 11:25

I will discuss a recent preprint with Alex Dunlap, where we study "V-shaped" solutions to the KPZ equation. These are solutions having asymptotic slopes $\theta > 0$ and $-\theta$ at plus and minus infinity, respectively. We show that there are no V-shaped invariant measures for the KPZ equation, which, combined with recent work of Janjigian, Rassoul-Agha, and Seppäläinen, completes the classification of the extremal invariant measures for the KPZ equation. To accomplish this, we study the fluctuations of viscous shocks in the KPZ equation under some special choices of initial data. While V-shaped invariant measures in a fixed frame of reference do not exist, we give an explicit description of a family of V-shaped invariant measures from the perspective of a shock.

Philippe Sosoe (Cornell University):
Regularity conditions in CLT for linear statistics of random matrices
Fri 10:45

The variance of linear statistics in random matrices is well known to be sensitive to the regularity of the test functions. In this talk, I will discuss work with Ben Landon on a near optimal CLT for linear statistics of Wigner matrices and recent related developments.

Bálint Vető (University of Toronto):
The Brownian web distance
Tue 09:00

Coalescing simple random walks in the plane form an infinite tree. A natural directed distance on this tree is given by the number of jumps between branches when one is only allowed to move in one direction. The Brownian web distance is the scale-invariant limit of this directed metric. It is integer-valued and has scaling exponents 0:1:2 as compared to 1:2:3 in KPZ universality. Yet, this model is still in the KPZ universality class. I will explain why.

Joint work with Bálint Virág.

Van Vu (Yale):
Eigenvalues under random perturbation
Mon 10:45

We discuss a new method to bound the fluctuation of the eigenvalues of a matrix under the addition of a random matrix. Examples include both the largest and smallest (in absolute value) eigenvalues.

Lingfu Zhang (Caltech):
Half-Space Stationary Horizon
Wed 09:40

For solvable last-passage percolation and directed polymer models, the Busemann functions for all slopes have been constructed using queueing processes. These further yield the joint stationary measure of the KPZ equation and the KPZ fixed point (i.e., the KPZ/stationary horizon), enabling many advances such as the uniqueness and stability of the stationary measures. (This line of research is in a series of works by Busani, Fan, Groathouse, Janjigian, Rassoul-Agha, Seppäläinen, Sorensen, among others.) In works in preparation with Duncan Dauvergne, we construct Busemann functions for all slopes in the half-space setting. This also extends the result of Barraquand-Corwin, which established the one-slope marginals. By taking appropriate scaling limits, we derive the half-space KPZ/stationary horizon. These further lead to a construction of the half-space directed landscape and certain convergence to it, leveraging our recently developed characterization techniques as well as the half-space TASEP convergence by X. Zhang.

Abstracts of Short Talks

Kartick Adhikari (IISER Bhopal, India):
Local weak limit of sparse random uniform hypegraphs
Tue 17:57

We consider k-uniform random hypergraphs on n vertices, where each hyperedge of size k is chosen independently and with probability p. In particular, $k = 2$ gives the Erdős-Rényi graphs. It is known that the sparse Erdőos-Rényi has a.s. local weak limit the Galton-Watson tree with Poisson offspring distribution. We show that the local limit of the sparse k-uniform random hypergraphs is the k-block Galton-Watson tree with Poisson offspring distribution. This is based on an ongoing work with Samiron Parui.

Arvind Ayyer (Indian Institute of Science):
GOE fluctuations in Alternating Sign Matrices
Mon 17:56

Sudeshna Bhattacharjee (Indian Institute of Science, Bengaluru):
Law of fractional logarithm for the GUE minor process
Thu 16:37

The Gaussian unitary ensemble (GUE) minor process is defined as the sequence of top $n \times n$ submatrices G_n of an infinite GUE matrix. It is well known that under appropriate centering and scaling the sequence of the largest eigenvalues λ_n of G_n converges weakly to the GUE Tracy-Widom distribution as $n \to \infty$. The question of a law of fractional logarithm for this sequence was considered and partially answered by Paquette and Zeitouni (Ann. Probab., 2017). In particular, they showed that after a further scaling of $(\log n)^{2/3}$ (resp. $(\log n)^{1/3}$), the $\limsup$ (resp. $\liminf$) of the centered and scaled sequence almost surely converges to some non-zero and finite constant. In this work we complete this picture by determining the explicit constant for the $\liminf$, confirming their conjecture. A key ingredient for our work is understanding the correct decorrelation scale for the sequence. To achieve this, we crucially use a correspondence between the Brownian last passage percolation and the GUE minor process due to Baryshnikov (Probab. Theory and Related Fields, 2001).

Thomas Buc-d'Alché (ENS de Lyon/UMPA, Lyon):
Topological expansion of unitary integrals and maps
Tue 16:40

The problem of computing the large N asymptotics of multi-matrix models may be reduced in some cases to the computation of integrals over the unitary group. We explain how these asympotics may be computed (in the perturbative regime) using Weingarten calculus and Dyson-Schwinger equations. The terms of the asymptotic expansion may then be expressed in terms of maps, i.e. graphs embedded in surfaces. The particular maps involved generalize the monotone Hurwitz numbers.

Kailun Chen (Leipzig University):
Appications of random walks on hecke algebras
Mon 17:44

Recently, random walks on Hecke algebras were recognized by A. Bufetov as a natural framework for the study of multi-species interacting particle systems. As a corollary, the Mallows measure can be viewed as the universal stationary blocking measure of interacting particle systems arising from random walks on Hecke algebras. Furthermore, the involution in Hecke algebras implies the color-position symmetry, which is a powerful tool for the asymptotic analysis of multi-species interacting particle systems. In this talk, we explore two facets of random walks on Hecke algebras. The first part focuses on the asymptotic behavior of the Mallows measure. In the second part, we consider applications of the color-position symmetry, particularly in the context of shock fluctuations in the half-line open Totally Asymmetric Simple Exclusion Process (TASEP) and Asymmetric Simple Exclusion Process (ASEP).

Yang Chu (UC Berkeley):
Multi-players Tug-of-war and exclusion processes
Tue 16:52

We study a system of PDEs corresponding to the simple exclusion process with absorbing boundary conditions. Such PDEs could be viewed as the value functions of multi-players version of random turn Tug-of-war games with blocking mechanisms. We show these PDEs have explicit solutions and a Gibbs resampling property.

Sabrina Gernholt (University of Bonn):
TASEP with a moving wall and generic initial conditions
Thu 18:10

We study the totally asymmetric simple exclusion process (TASEP) on the integers with a rightward-moving wall that blocks particle jumps. For the step initial condition, its asymptotic fluctuations are described by variational formulas. In this talk, we extend these results to generic initial data. Using colour-position symmetry, we derive a novel variational expression for the one-point distributions at finite times. This formula is then applied to analyse the model's large-time behaviour under both deterministic and random initial conditions. This talk is based on the preprint arXiv:2412.03370.

Victor Ginsburg (UC Berkeley):
Critical last passage percolation
Mon 17:20

Last passage percolation (LPP) is a model of random geometry where the main observable is a directed path evolving in a random environment. When the environment distribution has light tails and a fast decay of correlation, the random fluctuations of LPP are predicted to be explained by the Kardar-Parisi-Zhang (KPZ) universality theory. However, the KPZ theory is not expected to apply in many natural settings, such as "critical" environments exhibiting a hierarchical, fractal-like structure which should give rise to a fluctuation theory featuring logarithmic corrections with novel critical exponents. Predictions for these exponents are missing, even from the physics literature.

In recent joint work with Shirshendu Ganguly and Kyeongsik Nam we initiated the study of LPP in hierarchical environments, developing a framework based on multi-scale analysis and obtaining bounds on critical exponents for two canonical examples: an i.i.d. environment with critical power-law tails, and a hierarchical approximation of the two-dimensional Gaussian Free Field. This will be a two part talk. In the first short talk, I will describe these models and formulate our results. On Thursday June 26, Shirshendu will continue this discussion, giving a more comprehensive overview of our work and touching upon ongoing work with Kaihao Jing exploring connections to fractal percolation as well as related polymer models.

Helene Götz (TU Dortmund):
Nonstandard Large and Moderate Deviations for the Laguerre Ensemble
Thu 18:34

We show limit theorems for the weighted spectral measure of the Laguerre ensemble under a nonstandard scaling, when the parameter grows faster than the matrix size. For this parameter scaling, the limit behavior is similar to the case of the Gaussian ensemble. We show a large deviation principle, moderate deviations and a CLT for the spectral measure. For the moderate deviations and the CLT, we observe a particular dependence on the rate of the parameter and a corrective shift by a signed measure. The proofs are based on the tridiagonal representation of the Laguerre ensemble.

Ella Hiesmayr (ENS Lyon):
The Spectral Edge of Constant Degree Erdős-Rényi Graphs
Tue 18:21

It is known that the square of the largest eigenvalue of the adjacency matrix of an Erdős-Rényi graph with constant average degree is approximately equal to the maximum degree. In this paper we prove that the largest eigenvalues can be more precisely determined by small neighborhoods around vertices with maximum degree, and that its eigenvector is exponentially localized. This is joint work with Theo McKenzie.

Kateryna Hlyniana (Jilin University, China):
Gaussian Structure in Coalescing Stochastic Flows
Thu 17:01

In this talk, I will discuss the Gaussian limiting process of linear functionals of Brownian flows with coalescence, based on my joint work with Andrey Dorogovtsev.

Angeliki Koutsimpela (University of Augsburg):
Tagged particles and size-biased dynamics in mean-field interacting particle systems
Tue 17:16

We establish a connection between tagged particles and size-biased empirical processes in interacting particle systems, in analogy to classical results on the propagation of chaos. In a mean-field scaling limit, the evolution of the occupation number on the tagged particle site converges to a time-inhomogeneous Markov process with non-linear master equation given by the law of large numbers of size-biased empirical measures. The latter are important in recent efforts to understand the dynamics of condensation in interacting particle systems.

Joint work with Stefan Grosskinsky (University of Augsburg).

Kiran Kumar (NYU Abu Dhabi):
Random Simplicial Complexes in thermodynamic regime
Mon 17:32

Linial-Meshulam complex is a random simplicial complex on n vertices with a complete $(d-1)$-dimensional skeleton and d-simplices occurring independently with probability p. Linial-Meshulam complex is one of the most well-studied generalizations of the Erdős-Rényi random graph in higher dimensions.

Vlad Margarint (University of North Carolina at Charlotte):
A bridge between Random Matrix Theory and Schramm-Loewner Evolutions Theory
Thu 16:49

I will describe a newly introduced toolbox that connects two areas of Probability Theory: Schramm-Loewner Evolutions and Random Matrix Theory. This machinery opens new avenues of research that allow the use of techniques from one field to another. One aspect of this research direction is centered in an interacting particle systems model, namely the Dyson Brownian motion. I will first describe the toolbox and then I will describe one of the recent applications. Then, I am to describe some of the interesting open problems that emerge using this newly introduced toolbox. This is a joint work with A. Campbell and K. Luh.

Martin Malvy (ENS/CEREMADE, Paris Dauphine-PSL):
Long-range correlations for the Sine beta process
Thu 16:25

The Sine beta point process appears in Random Matrix Theory as the scaling limit of eigenvalues of celebrated random matrix models, and it corresponds to an infinite Log-gas in Statistical Mechanics. Valkó and Virág described its law using a family of coupled Stochastic Differential Equations known as the Brownian carousel. This characterization provides a powerful tool for understanding several fine statistics. In this talk, we will use this representation to prove the polynomial decay of correlations of the Sine beta process at large distances, for general values of beta. This result is a first step towards a conjecture due to Haldane, which gives a precise asymptotic of the two-points correlation functions and has been proven by Forrester for rational beta's only. Based on a joint work with Laure Dumaz.

Sam McKeown (UW-Madison):
An FPP model for minimal train journey costs
Tue 18:09

We consider the following situation: a passenger at Station A wishes to get to Station Z, which lies at the opposite end of a train line. Fare between neighbouring stations differ by day (as i.i.d. random variables), and our passenger would like to know the lowest possible cost of the journey in a given time limit. Two regimes are especially amenable, roughly when many stations must be traversed in a small time, and so there is little choice of route; or when very few stations must be traversed and there is lots of choice.

This problem is equivalent to a certain first passage percolation model on the plane. The many-station limit leaves us with the well-known Brownian last passage percolation, but the few-station limit appears to be new and leads to a semi-continuous model related to the Bessel kernel. We discuss universality in these regimes, giving asymptotics for journey costs and Tracy-Widom fluctuations under general assumptions on the fare distribution.

Yahui Qu (UW-Madison):
Pair correlation function for Sine-beta process
Tue 17:45

In this talk, we will introduce random Dirac operators, which can be regarded as the limit of certain unitary random matrices as the size goes to infinity. From studying the random operators, we give certain representation of the pair correlation function of Sine-beta process. And we show the correlation function is continuous in beta.

Gabriel Raposo (UC Berkeley):
Fluctuations for Standard Young Tableaux via 2d Gaussian fields
Tue 17:04

The study of random partitions is a classical topic in probability theory with several properties being shared with the eigenvalues of random matrices and other integrable models. After identifying normalized characters on the symmetric group S_n with probability measures on partitions of n, we characterize the law of large numbers and the central limit theorem for such distributions. As an application of these results, we further present a framework to obtain $2d$ Guassian field fluctuations for partitions obtained from uniform random standard Young tableaux.

CANCELLED: Ray Zhang (University of Utah):
An Upper Tail Field of the KPZ Fixed Point
Thu 16:25

The KPZ fixed point is a (1+1)-dimensional space-time random field conjectured to be the universal limit for models within the Kardar-Parisi-Zhang (KPZ) universality class. We consider the KPZ fixed point with the narrow-wedge initial condition, conditioned on a large value at a specific point. By appropriately zooming in on the neighborhood of this high point, we obtain a limiting random field, which we refer to as an upper tail field of the KPZ fixed point.

Unlike the KPZ fixed point, where the time parameter must be nonnegative, the upper tail field is defined in the full two-dimensional space. Notably, when zooming out the upper tail field appropriately, it exhibits a Brownian-type behavior in the negative time regime and resembles the KPZ fixed point in the positive time regime. A key component of our proof is an upper tail estimate for the joint tail probability functions of the KPZ fixed point near the given point, generalizing the well-known one-point upper tail estimate of the GUE Tracy-Widom distribution. This is joint work with Zhipeng Liu.

Panagiotis Zografos (Leipzig University):
Domino tilings of the Aztec diamond in random environment
Thu 18:22

It is well-known that under certain choice of weights random domino tilings of the Aztec diamond can be analyzed via Schur measures on partitions. In this talk we will discuss the model in which the parameters of the Schur measure (or, equivalently some weights of dominoes) are random themselves. We establish the limit shape and global fluctuations results via the technique of Schur generating functions. The talk is based on joint work with Alexey Bufetov and Leonid Petrov.