Probability and Statistical Mechanics
Probabilités et statistique mécanique
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ANTONIO AUFFINGER, Northwestern

LINAN CHEN, McGill University
Thick Points of Higher-Dimensional Gaussian Free Fields

Thick points of continuum Gaussian Free Fields (GFF) are analogs of extrema (or near extrema) of discrete GFFs, which are important objects for characterizing the "landscape" of GFFs. The geometry of the set of thick points, e.g., the Hausdorff dimension, of the 2D continuum GFF has been studied by Hu-Miller-Peres (2010). More generally, similar results are found to hold for general log-correlated Gaussian fields. In this talk, we will explain how to extend the study of thick points to continuum GFFs in higher dimensions in which case the Gaussian fields will be polynomially correlated. In particular, we will introduce a recent result on the Hausdorff dimension of the sets of thick points of GFFs in R^d for any d>2.

WEI-KUO CHEN, School of Mathematics, University of Minnesota
Fluctuations of the free energy in the mixed p-spin models with external field

The property of superconcentration in the mixed p-spin models with no external field, established by Chatterjee, states that the fluctuation of the free energy is of a smaller order than the usual one suggested by the Poincaré inequality. This talk will complement Chatterjee's result by showing that the free energy does not superconcentrate in the presence of external field. For models without odd p-spin interactions for $p \geq 3$, we will further establish the central limit theorem for the free energy at any temperature and give an explicit formula for the limiting variance.

MICHAEL DAMRON, Georgia Institute of Technology, Indiana University
Bigeodesics in first-passage percolation

In first-passage percolation, we place i.i.d. continuous weights at the edges of $\mathbb{Z}^2$ and consider the weighted graph metric. A distance minimizing path between points x and y is called a geodesic, and a bigeodesic is a doubly-infinite path whose segments are geodesics. It is a famous conjecture that almost surely, there are no bigeodesics. In the '90s, Licea-Newman showed that, under a curvature assumption on the "asymptotic shape," there are no bigeodesics with one end directed in some deterministic subset D of $[0, 2\pi)$ with countable complement. I will discuss recent work with Jack Hanson in which we show that there are no bigeodesics with one end directed in any deterministic direction, assuming the shape boundary is differentiable. This rules out existence of ground state pairs for the related disordered ferromagnet whose interface has a deterministic direction.

LAURA ESLAVA, McGill University
Depth of high-degree vertices in Random Recursive Trees

A random recursive tree T_n is constructed, recursively, by adding to T_{n-1} a new vertex n attached to a uniformly chosen vertex $j \in V(T_{n-1})$, while T_1 consist of a single vertex labelled 1.

In this talk we will be concern with the degree and depth of a vertex i, denoted by $\deg(i)$ and $\mathrm{ht}(i)$ respectively. Two known results for a uniformly chosen vertex $u \in T_n$ are convergence in distribution of $\deg(u)$ to a geometric r.v. $\mathrm{Geo}(1/2)$ and of $(\mathrm{ht}(u) - \ln n)/\sqrt{\ln n}$ to a normal random variable. On the other hand, Devroye and Lu proved that the maximum degree Δ_n

of T_n satisfies $\Delta_n/\log n \to 1$ a.s. and Goh and Schmutz obtained asymptotic tail bounds for $\Delta_n - \lfloor \log n \rfloor$. However, little was known about the properties of vertices with near-maximum degree.

In this talk we present an alternative construction of T_n which gives a new insight on both the degree and depth of its vertices. It allows us to recover and extend some of the results above mentioned, and furthermore we prove the asymptotic normality of the depth of vertices with near-maximum degree. Finally, interesting on its own, this alternative construction of random recursive trees is based on Kingman's coalescent and is also related to the data structure tree known as 'Union-Find'.

MICHAEL KOZDRON, University of Regina
Investigating the Hitting Distribution of the Unit Circle by Chordal SLE in the Upper Half Plane

The Schramm-Loewner Evolution (SLE) is a one-parameter family of random growth processes in the complex plane introduced in 2000 by the late Oded Schramm that has proven fundamental to our understanding of many 2D statistical mechanics models at criticality. However, the path properties of SLE are also of mathematical interest. In this talk we will discuss one such property, namely the hitting distribution of the unit circle by chordal SLE in the upper half plane. While we are not able to rigorously prove any theorems, we will discuss some numerical simulations which suggest a very tantalizing conjecture.

XINYI LI, ETH Zurich
A lower bound for disconnection by simple random walk

We consider simple random walk on $\mathbb{Z}^d$, $d \geq 3$. Motivated by the previous work of A.-S. Sznitman and the speaker, we investigate the asymptotic behaviour of the probability that a large body gets disconnected from infinity by the set of points visited by a simple random walk. We derive asymptotic lower bounds that bring into play random interlacements. Although open at the moment, some of the lower bounds we obtain possibly match the asymptotic upper bounds recently obtained in arXiv:1412.3960. This potentially yields special significance to the tilted walks that we use in this work, and to the strategy that we employ to implement disconnection.

JONATHAN NOVAK, UCSD

DIMITRY PANCHENKO, University of Toronto
On structure of Gibbs measures in dilute spin glass models

I will describe some results that provide partial support to the hypotheses of physicists on the structure of Gibbs measures in dilute spin glass models, such as dilute Sherrington-Kirkpatrick model or random K-sat model.

JONATHON PETERSON, Purdue University
Excited random walks in cookie environments with Markovian cookie stacks

Excited random walks (also called cookie random walks) are a model of self-interacting random motion where the transition probabilities depend on the past behavior of the walk through the local time at the present site. Known results for the model include (1) an explicit characterization of recurrence/transience, (2) an explicit characterization of ballisticity, and (3) a characterization of the limiting distributions for excited random walks, but most of these prior results relied on the assumption of "boundedly many cookies per site." Recently, however, Kozma, Orenshtein, and Shinkar studied the case where the cookie sequences are given by a deterministic periodic sequence at each site and proved an explicit characterization of recurrence/transience for such excited random walks. In this paper we consider a more general model where the cookie sequence at each site is given by the realization of a finite state Markov chain. This model generalizes both the case of periodic cookie sequences and many instances of boundedly many cookies per site. We are able to extend many of the known results from the boundedly many cookies case to our setup, including characterizations of recurrence/transience, ballisticity, and limiting distributions in the transient case. This talk is based on joint work with Elena Kosygina.

MYKHAYLO SHKOLNIKOV, Princeton University
On multilevel Dyson Brownian motions

I will discuss how Dyson Brownian motions describing the evolution of eigenvalues of random matrices can be extended to multilevel Dyson Brownian motions describing the evolution of eigenvalues of minors of random matrices. The construction is based on intertwining relations satisfied by the generators of Dyson Brownian motions of different dimensions. Such results allow to connect general beta random matrix theory to particle systems with local interactions, and to obtain novel results even in the case of classical GOE, GUE and GSE random matrix models. Based on joint work with Vadim Gorin.

HENNING SULZBACH, McGill University, Montreal
Triangulations, dual trees and fractal dimensions

In a classical work from 1994, David Aldous shows that a uniformly chosen triangulation of the n-gon converges in distribution to the so-called Brownian triangulation of the disk, both in the Hausdorff distance as well as with respect to the underlying dual trees. Curien and Le Gall (2011) introduce recursive laminations of the polygon and the disk, and prove their convergence on the level of random compact sets. We show that the corresponding dual trees converge (in to the so-called Gromov-Hausdorff-Prokhorov topology) and characterize the limiting object by a stochastic fixed-point equation on the space of random real trees. We also study fractal properties of the limiting object, thereby determining its Minkowski and Hausdorff dimension. Finally, we discuss generalizations of our results to related structures. This is joint work with Nicolas Broutin from INRIA, Paris.

HAO WU, NCCR/SwissMAP, University of Geneva, Switzerland
Level lines of Gaussian Free Field

The relationship between SLE and GFF is at the heart of recent breakthroughs in random conformal geometry. The work by Oded Schramm, Scott Sheffield, and Julien Dubedat shows that the level lines of GFF are SLE(4) curves. In this talk, we first explain what is the level line of GFF. Second, we explain the geometric properties of boundary emanating level lines. Finally, we discuss the geometric properties of interior emanating level lines.

GOKHAN YILDIRIM, York University
Directed polymers in a random environment with a defect line

The directed polymer in a random environment (DPRE) models a one-dimensional object interacting with disorder. The $1+1$ dimensional version of the model first was studied in the physics literature by Huse and Henley as a model for the interface in two-dimensional Ising models with random exchange interaction. We show that the difference between quenched and annealed free energies is of order β^4 as $\beta \to 0$, assuming only finiteness of exponential moments of the disorder values, improving existing results which required stronger assumptions.

A related problem is the competition between extended and point defects as reflected in pinning phenomena, arising for example in the context of high-temperature superconductors. On a lattice this can be described by a random potential, typically i.i.d. at each lattice site, representing the point defects, with an additional fixed potential u added for sites along some line, representing the extended defect. The polymer must choose between roughly following the extended defect, or finding the best path(s) through the point defects. As u is decreased, one expects a depinning transition at some critical u_c where the polymer ceases to follow the extended defect.

We show that for small inverse temperature β the quenched and annealed free energies differ significantly at most in a small neighborhood (of size of order β) of the annealed critical point $u_c^a = 0$.

This is a joint work with Kenneth S. Alexander.