Probability
Probabilité
(Org: **Jeremy Quastel** (Toronto) and/et **Tom Salisbury** (York))

LOUIGI ADDARIO-BERRY, McGill University
The spectral gap of random lifts

Joint work with Simon Griffiths. For a fixed d-regular graph H, a random n-lift is obtained by replacing each vertex v of H by a "fibre" containing n vertices, then placing a random matching between adjacent fibres. We show that with high probability, all eigenvalues of the lift that are not eigenvalues of H ("new" eigenvalues), have order $O(\sqrt{d})$, and that any exceptionally large new eigenvalues are with high probability caused by a dense subgraph of size $O(|E(H)|)$.

LOUIS-PIERRE ARGUIN, Université de Montréal
The extremal process of branching Brownian motion

Branching Brownian motion (BBM) is a Markov process where particles perform Brownian motion and independently split into two independent Brownian particles after an exponential holding time. The extreme value statistics of BBM in the limit of large time is of interest since BBM constitutes a borderline case, among Gaussian processes, where correlations start to affect the statistics. The law of the maximum of BBM has been understood since the works of Bramson, McKean, and Lalley and Sellke. But little is known about the distribution of the particles close to the maximum. In this talk, I will present how these previous results and the use of an appropriate auxiliary process (akin to the cavity method in spin glasses) can be used to prove that the extremal process of BBM is a Poisson cluster process. This is joint work with A. Bovier and N. Kistler.

ILIA BINDER, University of Toronto
Schramm Loewner Evolution, Conformal welding, and Multifractal spectrum

A few non-equivalent ways of obtaining Schramm Loewner Evolution (SLE) from conformal welding. Some of them are now proven to produce SLE, while the same question about other methods still remain open. We will discuss the two-sided multifractal spectrum as a way of checking the plausibility of the relation of the resulting welded curves and SLE.

This is a joint work with K. Izurov and S. Smirnov.

ALEX BLOEMENDAL, Harvard University
Continuum limits of spiked random matrices

The top eigenvalues of finite-rank perturbed random matrices are known to exhibit a phase transition in the large size limit. I will discuss joint work with B. Virág in which we identify the limiting behaviour near the transition. It can be understood in terms of a continuum random Schrödinger operator on the half-line, with boundary condition depending on the perturbation; we derive another characterization in terms of a linear PDE related to Dyson's Brownian motion. In the complex case we recover known Painlevé representations for these deformations of the Tracy-Widom distribution.

DAVID BRYDGES, University of British Columbia
A renormalisation group analysis of the 4-dimensional weakly self-avoiding walk

We discuss recent joint work with Gordon Slade which proves $|x|^{-2}$ decay of the critical two-point function for the continuous-time weakly self-avoiding walk on Z^4. The walk two-point function is identified as the two-point function of a supersymmetric field theory with quartic self-interaction, and the field theory is then analysed using renormalisation group methods.

VADIM KAIMANOVICH, University of Ottawa
Invariance and unimodularity for random graphs

The space of rooted locally finite graphs has a natural "root moving" equivalence relation, so that one can talk about measures on the above space invariant with respect to this equivalence relation. A close notion of a "unimodular measure" has been recently introduced by probabilists. Although for measures supported on rigid graphs unimodularity is equivalent to invariance, they may differ in general. In the talk we shall clarify the relationship between these two notions.

KONSTANTIN KHANIN, Toronto

TERMEH KOUSHA, University of Ottawa
Asymptotic behavior and moderate deviation principle for the maximum of a Dyck path

By using a representation of the Catalan number, relying on the spectral properties of an associated adjacency matrix, we find the distribution of the maximum of Dyck path for the case where the length of the Dyck path is proportional to the square root of the height. We also consider other cases and find moderate and large deviation principles for the law of the maximum of random Dyck path for those cases.

ALEXEY KUZNETSOV, York University
What do stable Levy processes have in common with Quantum Topology?

Stable processes are self-similar Levy processes, thus one would expect that the study of these processes would require mostly probabilistic tools, such as excursion theory, Lamperti transformation, etc. Surprisingly, the problem of obtaining the distribution of extrema of stable processes is closely related to elliptic functions, lattices and Diophantine approximations. In this talk we will discuss our recent results on extrema of stable processes, highlight connections with other areas of Mathematics and present some open questions.

NEAL MADRAS, York University
Empty Regions of Random Pattern-Avoiding Permutations

A *pattern* of length k is simply a permutation of $\{1, .., k\}$. A permutation of $\{1, ..., N\}$ (for $N > k$) is said to avoid a specific pattern P if the (long) permutation has no subsequence of k elements that appears in the same relative order as P. (E.g. the permutation (6425713) does not avoid the pattern (132) because the permutation contains the subsequence (273).) For a given pattern P, let $S_N[P]$ be the subset of permutations of $\{1, .., N\}$ that avoid P. The cardinality of $S_N[P]$ has been extensively studied by combinatorialists.

This talk examines properties of random elements of $S_N[P]$. Monte Carlo experiments reveal some striking features when these random permutations are graphed as functions from $\{1, .., N\}$ to $\{1, .., N\}$. We prove that for some patterns, certain regions of $[1, N]^2$ are exponentially unlikely to contain any points of such a graph. We characterize which patterns produce such "empty regions."

This is joint work with Mahshid Atapour.

LERNA PEHLIVAN, York University
Top to Random Shuffles and Number of Fixed Points

Number of fixed points is studied for random permutations and for some shuffles such as riffle shuffles. Considering that we have a permutation obtained after a number of top to random shuffles we provide the formulas for the expected value and the variance of the number of

fixed points.

LEA POPOVIC, Concordia

DANIEL REMENIK, University of Toronto
The endpoint distribution of directed polymers in 1+1 dimensions

Directed polymers in 1+1 dimensions belong to the KPZ universality class, a class of models including also some random growth models and interacting particle systems which feature an unusual size and scale of fluctuations, with distributions which are often related to random matrix theory. In this talk I will describe how to obtain a formula for the endpoint distribution of a point-to-line polymer, which is obtained as the distribution of the argmax of the Airy_2 process minus a parabola. The derivation uses a formula for the continuum statistics of the Airy_2 process.

This is joint work with Ivan Corwin, Gregorio Moreno Flores and Jeremy Quastel.

CHRISTIAN SADEL, University of California, Irvine
Absolutely continuous spectrum and ballistic behavior for random Schrödinger operators on the Bethe Strip

The Bethe strip is the cross product of the Bethe lattice with a finite set. On this set we consider random Schrödinger operators given by the tensor sum of the Laplacian on the Bethe lattice with a fixed vertical operator plus a random matrix potential with some coupling constant. If the randomness is small enough we find that these operators have purely absolutely continuous spectrum in some energy interval with probability one and moreover, the spreading of wave packets under the quantum evolution is ballistic. The proof uses supersymmetric integral expressions for the matrix Green's functions.

YVAN SAINT-AUBIN, Université de Montréal
The algebraic properties of the 2d lattice models

Two recent Fields medals have brought the field of two-dimensional statistical physics to the attention of the mathematical community. Werner, together with Lawler and Schramm, showed how many physical observables can be studied rigorously using the stochastic Loewner evolution, and Smirnov that percolation and the Ising model are conformally invariant. There remain many mathematical problems intimately related to physical conjectures describing these models. I will present recent efforts to describe how the algebraic structure of conformal transformations might appear from discrete probabilistic lattice models.

DENIZ SEZER, Calgary

NARN-RUEIH SHIEH, Taiwan University and York University
Multi-scaling Limits for Relativistic Diffusion Equations with Random Initial Data

Let $u(t,\mathbf{x}),\ t>0,\ \mathbf{x}\in\mathbb{R}^n$, be the spatial-temporal random field arising from the solution of a relativistic diffusion equation with the spatial-fractional parameter $\alpha\in(0,2)$ and the mass parameter $\mathfrak{m}>0$, subject to a random initial condition $u(0,\mathbf{x})$ which is characterized as a subordinated Gaussian field. In this talk, we report the large-scale (the macro) and the small-scale (the micro) limits for the renormalization of the solution field $u(t,\mathbf{x})$. Both the Gaussian and the non-Gaussian limit theorems are discussed. The small-scale scalings involve not only to scale on $u(t,\mathbf{x})$ but also to rescale the initial data $u(0,\mathbf{x})$; this is a new-type result for the literature. In the two scalings, the parameter α and the parameter $\mathfrak{m}$ play distinct roles for the scaling (renormalizing) and the limiting procedures. A working project with G.-R. Liu.

GORDON SLADE, University of British Columbia
A renormalisation group analysis of the 4-dimensional weakly self-avoiding walk

We discuss recent joint work with David Brydges which proves $|x|^{-2}$ decay of the critical two-point function for the continuous-time weakly self-avoiding walk on $\mathbb{Z}^4$. The walk two-point function is identified as the two-point function of a supersymmetric field theory with quartic self-interaction, and the field theory is then analysed using renormalisation group methods.

BALINT VIRAG, University of Toronto
Random Toeplitz matrices

Random Toeplitz matrices are in the exciting area in between the usual Wigner random matrices and random Schroedinger operators. I will present several open questions and answer two. First, that the limiting eigenvalue distribution is absolutely continuous. Second, that the top eigenvalue, suitably normalized, converges to the 2-4 operator norm of the renowned Sine kernel.

Joint work with Arnab Sen (Cambridge).

XIAOWEN ZHOU, Concordia University
The occupation times for spectrally negative Lévy process

This talk in on the Laplace transforms of the occupation times for a spectrally negative Lévy process. For Brownian motion such a result can be obtained by the Feynman-Kac representation and solving a differential equation. We want to introduce a different approach using the solutions to exit problems for the Lévy process. We are going to show that these Laplace transforms could be eventually expressed in terms of the Laplace exponent and the scale function for the corresponding Lévy process.

This talk is based on joint work with David Landriault, Ronnie Loeffen and Jean-Francois Renaud.