Rencontres de Probabilités 2021
Rouen, 21-22 octobre 2021

Programme

Thursday October 21 2021

10:50 - 12:30 mini-course Valentin Féray, 1 & 2 (with a break of 10 mn)
12:35 - 12:55 Short talk Benoit Dagallier
13:00 - 14:30 lunch
14:30 - 16:10 mini-course Patricia Gonçalves, 1 & 2
16:10 - 16:30 coffee break
16:30 - 17:10 talk Giambattista Giacomin
17:15 - 17:35 Short talk Ofer Busani
17:40 - 18:00 Short talk Barbara Dembin

Friday October 22 2021

09:00 - 10:40 mini-course Claudio Landim, 1 & 2
10:45 - 11:05 Short talk Stefano Marchesani
11:05 - 11:25 coffee break
11:25 - 12:05 talk Christophe Poquet
12:10 - 12:30 Short talk Monia Capanna
12:35 - 12:55 Short talk Ivailo Hartarsky
13:00 - 14:30 lunch
14:30 - 15:10 talk Alexandre Gaudillière
15:15 - 15:35 Short talk Réka Szabó
15:40 - 16:20 talk Dimitrios Tsagkarogiannis

Abstracts

Mini-courses

Valentin Féray (Université de Lorraine, Nancy)
Title: *Central limit theorems via (weighted) dependency graphs*

Abstract: We present the theory of dependency graphs, and a generalization recently introduced by the speaker, weighted dependency graphs. These theories give criteria for the asymptotic normality of sequences of random variables, applicable in particular to numbers of occurrences of "patterns" in various structures. We give examples ranging from probabilistic combinatorics (e.g., subwords in random texts) and stochastic geometry (length of the nearest neighbour graphs) to particle systems (symmetric simple exclusion process, Ising model).

Patricia Gonçalves (Instituto Superior Técnico, Lisboa)
Title: *Fluctuations of symmetric exclusion with an open boundary*

Abstract : n this mini-course I will describe the scaling limits of the exclusion process in contact with reservoirs. My goal is to describe the connection between the macroscopic (continuous) equations and the microscopic (discrete) system of random particles. The former can be either PDEs or stochastic PDEs depending on whether one is looking at the law of large numbers or the central limit theorem scaling; while the latter is a collection of particles that move randomly according to a transition probability and rings of Poisson processes.
Depending on the intensity of the boundary dynamics we will obtain different boundary conditions at the level of the hydrodynamic equations and also at the level of the fluctuations. The focus will be derivation of the fluctuations both in and out of equilibrium.
The mini-course will rely on the results of the articles below.

References.

Bernardin, C., Gonçalves, P., Jara, M., Scotta, S. (2021): *Equilibrium fluctuations for diffusive symmetric exclusion with long jumps and infinitely extended reservoirs*}}, to appear in AIHP, Prob. and Stats.

Bernardin, C., Gonçalves, P., Jiménez-Oviedo, B. (2021) : *A microscopic model for the regional fractional Laplacian with Dirichlet boundary conditions*, Archive for Rational Mechanics and Analysis, 239, 1-48.

Bernardin, C., Cardoso, P., Gonçalves, P., Scotta, S. (2021+): *Hydrodynamic limit for a super-diffusive symmetric exclusion in contact with reservoirs*, submitted.

Gonçalves, P., Jara, M., Neumann, A., Menezes, O. (2020): N*on-equilibrium and stationary fluctuations for a slowed boundary symmetric exclusion*, Stochastic Processes and their Applications, 130 no. 7, 4326-4357.

Claudio Landim (CNRS/Université de Rouen Normandie et IMPA Rio de Janeiro)
Title: *Metastable Markov chains*

Abstract: We review recent results on the metastable behavior of continuous-time Markov chains derived through the characterization of Markov chains as unique solutions of martingale problems.

Talks

Ofer Busani (Universität Bonn, Allemagne)
Title: *Universality of geodesic tree in last passage percolation*

Abstract: In Last Passage Percolation (LPP) one assumes i.i.d. weights on the lattice $\mathbb{Z}^2$. The geodesic from the anti-diagonal $h(x) = -x$ to the point (N, N) is an up-right path starting from h and terminating at (N, N) on which the total weight is maximal. Consider now a cylinder H of width $\varepsilon N^2/3$ and length $^{3/2}N$ centered around the point (N, N) and along the straight line going from the point $(0, 0)$ to the point (N, N). The geodesic tree consists of all the geodesics going from

h and terminating in the cylinder H. We show that for exponential LPP, for a large class of weights on $h(x)$ and with high probability, the geodesic tree coincides on H with a universal stationary tree. Based on joint works with Marton Balazs, Timo Seppäläinen and Patrik Ferrari.

Monia Capanna (Università dell'Aquila, Italie)
Title: *Hydrodynamic limit and critical asymptotic behaviour in the SIR model*

Abstract: In this talk I will analyze a model for the spread of an epidemic among a finite population with susceptible, infected and removed individuals (SIR). The infection mechanism depends on the relative distance between susceptible and infected so that an infected individual is more likely to infect nearby sites than those further away. For fixed time, we prove that the density fields weakly converge to the solution of a PDE's system, as the number of particles increases. We find an implicit expression for the final survivor density of the limit equation and we analyze the asymptotics of the microscopic system, by taking first the time and after the number of particles to infinity, showing a critical behavior for some values of the parameters.

Benoît Dagallier (Cambridge University, Royaume-Uni)
Title: *Anomalous correlation in the simple exclusion process with reservoirs*
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Abstract: Many systems out of equilibrium settle in long time in steady states with long range correlations. In the case of the one-dimensional symmetric simple exclusion process with reservoirs, these correlations are known explicitly. This model is used as a test case for the following question: how can one quantify the probability of observing correlations that differ from those of the steady state in long time and in the scaling limit? To answer this question, our main ingredient, of independent interest, is a refinement of the relative entropy method, as already recently improved by Jara and Menezes to study fluctuations. By incorporating the correlation structure of the dynamics into the relative entropy method, we obtain quantitative estimates good enough to probe the scaling, long time limits for correlations.

Barbara Dembin (ETH Zürich, Suisse)
Title: *The time constant for Bernoulli percolation is Lipschitz continuous strictly above p_c*

Abstract: We consider the standard model of i.i.d. first passage percolation on $\mathbb{Z}^d$ given a distribution G on $[0, +\infty]$ ($+\infty$ is allowed). When $G(\{+\infty\}) < p_c$, it is known that the time constant μ_G exists. We are interested in the regularity properties of the map $G \mapsto \mu_G$. We study the specific case of distributions of the form $G_p = p\delta_1 + (1-p)\delta_\infty$ for $p > p_c$. In this case, the travel time between two points is equal to the length of the shortest path between the two points in a bond percolation of parameter p. We show that the function $p \mapsto \mu_{G_p}$ is Lipschitz continuous on every interval $[p_0, 1]$, where $p_0 > p_c$.
This is a joint work with Raphaël Cerf.

Alexandre Gaudillière (CNRS, Université d'Aix-Marseille)
Title: *Kirchhoff forests and spectrum estimation*

Abstract: We show how one can use random spanning forests to get a rough estimation of the spectrum of a symmetric matrix by adding to the reading cost of the matrix a number of operations that is almost linear in the line number. This is a joint work with Matteo Quattropani, Fabienne

Castell, Clothilde Mélot, Nicolas Tremblay, Simon Barthelmé, Pierre-Olivier Amblard and Luca Avena.

Giambattista Giacomin (Université de Paris)

Title: *Products of random matrices and the statistical mechanics of disordered systems*

Abstract: The talk will focus on the top Lyapunov exponent of the transfer matrix for the nearest neighbor Ising chain with random external field. This Lyapunov exponent coincides with the free energy of the Ising chain with random external field, but it also plays a central role in the analysis of the two dimensional Ising model with columnar disorder and of the quantum chain with transverse random field.
The aims of the first part of the presentation will be motivations and review of the literature. The second part instead will be centered on a recent result on the sharp behavior of the Lyapunov exponent in the large interaction limit when the external field is centered: this balanced case turns out to be critical in many respects. From a mathematical standpoint we precisely identify the behavior of the top Lyapunov exponent of a product of two dimensional random matrices close to a diagonal random matrix for which top and bottom Lyapunov exponents coincide. In particular, the Lyapunov exponent is only log-Hölder continuous.

Ivailo Hartarsky (Université Paris Dauphine)

Title: *Bisection for kinetically constrained models*

Abstract: In this talk we examine the powerful bisection method for establishing relaxation time bounds. Initially introduced for kinetically constrained models by Cancrini, Martinelli, Roberto and Toninelli, it has been applied also in several other contexts such as solid on solid model interfaces. We will review the original argument and present a new probabilistic proof of the core two-block lemma. Our approach turns out to treat inhomogeneous one-dimensional kinetically constrained models in unprecedented generality. Nevertheless, our focus will be on the method, which we hope to be of use in other settings. The talk is based on https://arxiv.org/abs/2104.07883.

Stefano Marchesani (GSSI, L'Aquila, Italie)

Title: *Hyperbolic hydrodynamic limits and thermodynamic entropy solutions*

Abstract: We study the hydrodynamic limit of a anharmonic chain subject to boundary condition in the hyperbolic space-time scale. By suitably adding noise to the Hamiltonian dynamics the macroscopic equation is a nonlinear 2x2 system of PDEs (p-system), whose solutions develop shocks in a finite time.
We show that the empirical distribution of the microscopic system concentrates on L^2-valued solutions of the macroscopic equation, which are « physical » in the sense that they satisfy the second Law of Thermodynamics.

Christophe Poquet (Université Lyon 1 Claude Bernard)
Title: *Slow-fast dynamics and noise-induced periodic behaviors for mean-field excitable systems*

Abstract: We will study non-linear Fokker-Planck equations describing the infinite population limit of interacting excitable particles subject to noise. Taking a slow-fast dynamics limit, we will describe the emergence of periodic behaviors induced by the noise and the interaction, considering in particular the case in which each unit evolves according to the FitzHugh Nagumo model. We will then consider the longtime fluctuations of the particles system.

Réka Szabó (CEREMADE, Université Paris-Dauphine, Université PSL, CNRS)
Title: Improved bound for the contact process with sexual reproduction

Abstract: The contact process with sexual reproduction is a two-dimensional interacting particle system introduced by Durrett ('86) in which particles die at rate one and at each empty vertex a new particle is born at rate lambda given that both the north and east neighbours are occupied. By reviewing and extending Toom's classical result about stability of trajectories of cellular automata, we derive rigorous bounds for the critical parameter of this process. Joint work with Jan Swart and Cristina Toninelli.

Dimitrios Tsagkarogiannis (Università dell'Aquila, Italie)
Title: *Nonequilibrium fluctuations for current reservoirs*

Abstract: Stationary non equilibrium states are characterized by the presence of steady currents flowing through the system as a response to external forces. We model this process considering the simple exclusion process in one space dimension with appropriate boundary mechanisms which create particles on the one side and kill particles on the other. The system is designed to model Fick's law which relates the current to the density gradient. In this talk we focus on the fluctuations around the hydrodynamic limit of the system. The main technical difficulty lies on controlling the correlations induced by the boundary action. This is joint work with Panagiota Birmpa and Patricia Gonçalves.