Equilibrium and Non-equilibrium Statistical Mechanics

A conference in honor of François Du

Report of Contributions

https://indico.math.cnrs.fr/e/Florence2019

Contribution ID: **1** Type: **not specified**

Hydrodynamics and non-equilibrium stationary states for diffusive systems of conversation laws

Tuesday, April 9, 2019 2:40 PM (50 minutes)

We consider one dimensional dynamics of interacting particles that have more conserved quantities that evolve macroscopically in the same diffusive time scale, and their macroscopic evolution is governed by a system of coupled diffusive equations. Their non-equilibrium stationary states, driven by heat bath and external forces, present interesting phenomena like up-hill diffusion, negative linear response, internal eternalizations (non-monotous temperature profiles). One example is given by the chain of coupled rotors. That conserves the energy and the angular momentum. Mathematical rigorous results can be obtained in harmonic chains of oscillators perturbed by noise that have more than one conservation laws. there are some common universal features due tothe transformation of mechanical work into thermal energy done by the bulk dynamics. Works in collaborations with Tomasz Komorowski, Marielle Simon, Alessandra Iacobucci, Gabriel Stoltz

Presenter: OLLA, Stefano

Contribution ID: **2** Type: **not specified**

Large deviations and concentration of scaling limits for $(1+1)$ dimensional fields with Laplacian interaction with pinning and wetting

We study scaling limits and corresponding large deviation
principles of random fields perturbed by an attractive force towards the origin and/or by hard-wall (wetting) constraints. In particular, we analyse the critical situation that the rate function admits more than one minimiser leading to a concentration of measure problems.
Our models are in fact interface models with Laplacian interaction, and such linear chain models with Laplacian interaction appear naturally in the physics literature in the context of semi-flexible polymers. We discuss these connections as well as the ones with the related gradient models. These random fields are a class of model systems arising in the studies of random interfaces, critical phenomena, random geometry, field theory, and elasticity theory.

Presenter: ADAMS, Stefan

Contribution ID: **3** Type: **not specified**

Random walk in a non-integrable random scenery time.

Wednesday, April 10, 2019 2:10 PM (50 minutes)

In this talk we consider a one-dimensional process in random
environment, also known in the physical literature as Levy-Lorentz gas. The environment is provided by a renewal point process that can be seen as a set of randomly arranged targets, while the process roughly describes the displacement
of a particle moving on the line at constant velocity, and changing direction at the targets position with assigned probability.
We investigate the annealed behavior of this process in the case of inter-distances between targets having infinite mean, and establish, under suitable scaling, a functional limit theorem for the process. In particular we show that, contrary to the finite mean case, the behavior of the motion is super- diffusive with explicit scaling limit related to the Kesten-Spitzer process.
The key element of the proof is indeed a representation of the consecutive “hitting times on the set of targets” as a suitable random walk in random scenery.

Presenter: BIANCHI, Alessandra

Contribution ID: **4** Type: **not specified**

Hydrodynamic limit for a facilitated exclusion process.

Tuesday, April 9, 2019 9:50 AM (50 minutes)

We show a hydrodynamic limit for the exclusion process on $\mathbb{Z}$ in which a particle can jump to the right only if it has a particle to its left and vice-versa. This process has an active/inactive phase transition at density $\frac{1}{2}.
Joint work with Cément Erignoux, Makiko Sasada and Marielle Simon.

Presenter: BLONDEL, Oriane

Contribution ID: **5** Type: **not specified**

Chaos propagation for balls into bins dynamics.

Tuesday, April 9, 2019 1:50 PM (50 minutes)

We consider N balls and L bins. Initially the balls are randomly placed into the bins. At each time a ball is taken from every non empty bin. Then all the drawn balls are placed into the bins according to a definite law. The evolution is a Markov chain. The model is an interacting particle system with parallel updating so it is not reversible. We give conditions under which propagation of chaos holds and present three applications.

Presenter: CANCRINI, Nicoletta

Contribution ID: **6** Type: **not specified**

Microscopic stochastic particle models for Fick and Fokker- Planck diffusion equations

Wednesday, April 10, 2019 9:00 AM (50 minutes)

Diffusion in not homogeneous media can be described both by the Fick and the Fokker-Planck diffusion equation. The question whether one of the two description has to be considered the correct one is often debated in the scientific literature. Using a microscopic approach, we show that both the descriptions are reasonable and that they correspond to different realizations of spatial inhomogeneities.
This work is in collaboration with D. Andreucci (Roma), M. Colangeli (L'Aquila), and D. Gabrielli (L'Aquila).

Presenter: CIRILLO, Emilio

Contribution ID: **7** Type: **not specified**

Time scales in some large population birth and death processes, quasi stationary distribution and resilience.

Tuesday, April 9, 2019 3:50 PM (50 minutes)

With S.Meleard and J.-R.Chazottes we consider a birth and death process with one or several species depending on a (large) parameter giving the scale of the populations sizes. Assuming there is a unique globally attracting nontrivial fixed point for the rescaled infinite population dynamical system, we investigate (under some hypothesis) the time scale of global extinction and the existence and time scale of convergence to a quasi stationary distribution (q.s.d.). Together with S.Martinez we apply these results using micro-macro relations to recover the engineering resilience from the fluctuations of a sample of the process.

Presenter: COLLET, Pierre

Contribution ID: **8** Type: **not specified**

Gibbs states for (long-range) Ising models.

Monday, April 8, 2019 11:50 AM (50 minutes)

I will review old and present new results on standard and long-range Ising models in dimension 1, 2 and 3. I shall focus on fluctuations or rigidity of interfaces at low temperature, in the coexistence regime.
Based on works in collaboration with Y. Velenik (Geneva) on one hand, and A. van Enter (Groningen), A. Le Ny (Paris) and W. Ruszel (Delft) on the other hand.

Presenter: COQUILLE, Loren

Contribution ID: **9** Type: **not specified**

Fick's law with phase transitions.

Tuesday, April 9, 2019 11:50 AM (50 minutes)

The context is the Fick's law where a stationary current flows in a system driven by the boundaries which are put in contact with suitable reservoirs. This is a much studied problem but only recently together with Olla and Presutti I have obtained results in models with phase transition I will present these models where the stationary non equilibrium distribution is known explicitly and exploit this to compare the stationary fluctuations of the interface in this case where a non zero current is present, with those at thermal equilibrium.

Presenter: DE MASI, Anna

Contribution ID: **10** Type: **not specified**

Elliptic dimers and genus 1 Harnack curves.

Monday, April 8, 2019 3:50 PM (50 minutes)

Presenter: DE TILIÈRE, Béatrice

Contribution ID: **11** Type: **not specified**

Stochastic homogenization in amorphous media and applications to Mott variable range hopping.

Wednesday, April 10, 2019 11:00 AM (50 minutes)

By extending the method of 2-scale convergence we prove an homogenization theorem of difference operators given by Markov generators of random walks on random marked simple point processes with symmetric jump rates. Using this theorem, we derive two further results: (i) the hydrodynamic limit of the exclusion process given by multiple random walks with hard-core interaction; (ii) the a.s. convergence of the rescaled conductivity matrix of the Miller-Abrahams resistor network to the diffusion matrix of Mott random walk. The second result is related to Mott variable range hopping, which is a fundamental mechanism of phonon-induced electron conduction in amorphous solids given by strongly disordered solids as doped semiconductors.

Presenter: FAGGIONATO, Alessandra

Contribution ID: **12** Type: **not specified**

Wetting, disordered pinning and layering for discrete random interfaces

Monday, April 8, 2019 2:10 PM (50 minutes)

Solid-on-Solid (SOS) is a simplified surface model which has been introduced to understand the behavior of Ising interfaces in $\mathbb{Z}^d$ at low temperature. The simplification is obtained by considering that the interface is a graph of a function ϕ, $\mathbb{Z}^{d-1} \to \mathbb{Z}$. In the present talk, we study the behavior of SOS surfaces in $\mathbb{Z}^2$ constrained to remain positive, and interacting with a potential when touching zero, corresponding to the energy functional: $V(\phi) = \beta \sum_{x\sim y} |\phi(x)-\phi(y)| - \sum_x \left(hind_{\{\phi(x)=0\}} - \infty ind_{\{\phi(x)=0\}} \right) .We showthatif\beta$ is small enough, the system undergoes a transition from a localized phase where there is a positive fraction of contact with the wall to a delicalized one for $h_w(\beta) = \log\left(\frac{e^{4\beta}}{e^{4\beta}-1}\right) .Inadditionbystudyingthefreeenergy, weprovetha$

Presenter: LACOIN , Hubert

Contribution ID: **13** Type: **not specified**

The Discrete Non Linear Schroedinger Equation: an example of inequivalence between statistical ensembles.

Wednesday, April 10, 2019 3:00 PM (50 minutes)

The dynamics of the DNLSE is characterized by peculiar featuresin the region of parameter space above the line at infinite temperature:the deterministic version exhibits multi-breather states, lasting over astronomical times, while the stochastic (conservative)
evolution yields a coarsening dynamics to an infinite temperature
lattice, with a superimposed giant breather collecting a finite fractionof the total energy. The statistical mechanics of this model can be naturally described and explicitly computed in the microcanonical ensemble and allows us to conclude that the multi breather state, observed in the deterministic evolution, is a genuine equilibrium state at negative temperature. We also show that in this region there is no ensemble equivalence with the grand-canonical ensemble and, moreover, that the infinite temperature line is also the boundary of a first order phase transition between a thermalized (low-energy) phase and a condensed (high-energy) phase. Further details about the presence of a spinodal line, the features of the order parameter and the non-extensivity of the condensed phase will be also discussed.

Presenter: LIVI, Roberto

Contribution ID: **14** Type: **not specified**

Statistical forces and stabilization out-of-equilibrium.

Wednesday, April 10, 2019 9:50 AM (50 minutes)

We discuss the nature of induced forces on a probe coupled to a nonequilibrium medium. We show how stabilization of fixed points may be achieved because of nonequilibirum effects.

Presenter: MAES, Christian

Contribution ID: **15** Type: **not specified**

Universality for Kinetically Constrained Spin Models.

Tuesday, April 9, 2019 9:00 AM (50 minutes)

Kinetically constrained models (KCM) are reversible interacting particle systems with continuous time Markov dynamics of Glauber type, which have been extensively used in the physics literature to model the liquid-glass transition, a major and longstanding open problem in condensed matter physics. They also represent a natural stochastic (and non-monotone) counterpart of the family of cellular automata known as
$calU$-bootstrap percolation thoroughly analyzed by P. Balister, B.Bollobas, H. Duminil-Copin, R. Morris, P. Smith and A. Uzzell. I shall present a series of universality results for the mean infection time of the origin for KCM, which have been obtained in various collaborations with C. Toninelli, L. Mareche', I. Hartarski and R. Morris.

Presenter: MARTINELLI, Fabio

Contribution ID: **16** Type: **not specified**

Glassy states of the Ising model on trees and Lobachevsky plane.

Wednesday, April 10, 2019 11:50 AM (50 minutes)

I will explain that on trees and on Lobachevsky, the Ising model has a huge continuum of extremal states. As a result, the free state of the Ising model below the spin-glass temperature has a structure of a spin-glass state: it is a mixture of continuum many extremal states.
Joint work with D. Gandolfo, Ch. Maes, and J. Ruiz.

Presenter: SHLOSMAN, Senya

Contribution ID: **17** Type: **not specified**

Shaken dynamics for 2d Ising model.

Monday, April 8, 2019 3:00 PM (50 minutes)

We define a random dynamics which is a composition of two steps of parallel updating with interaction in opposite directions. The invariant measure of this dynamics turns out to be the marginal of the Gibbs measure of an Ising model on hexagonal graphs. The shaken dynamics can be applied to study the effect of earth tides on earthquakes.

Presenter: SCOPPOLA, Elisabetta

Contribution ID: **18** Type: **not specified**

One-sided versus two-sided dependence.

Monday, April 8, 2019 11:00 AM (50 minutes)

Stochastic systems can be parametrised by time (like Markov chains),in which conditioning is one-sided (the past)or by one-dimensional space (like Markov fields), where conditioning is two-sided (right and left).I will discuss some examples, in particular generalising this to g-measures versus Gibbs measures, where, instead of a Markovian dependence, the weaker property of continuity (in the product topology) is required. In particular I will discuss when the two descriptions (one-sided or two-sided) produce the same objects and when they are different.We show moreover the role one-dimensional entropic repulsion plays in this setting.
Joint work with R. Bissacot, E. Endo and A. Le Ny

Presenter: VAN ENTER, Aernout

Contribution ID: **19** Type: **not specified**

Kinetically constrained models in random environments

Tuesday, April 9, 2019 11:00 AM (50 minutes)

Kinetically constrained models are a family of interacting particle systems used by physicists in order to study the liquid-glass transition. They are characterized by a very simple non-interacting equilibrium, but their dynamics is slowed down by local kinetic constraints, leading to highly non-trivial behavior of time scales. We will discuss these time scales when adding quenched disorder to the system, focusing on one example of a model on the two dimensional lattice with random constraints.

Presenter: SHAPIRA, Assaf

Contribution ID: **21** Type: **not specified**

Introduction

Monday, April 8, 2019 10:40 AM (20 minutes)

Presenter: DUNLOP, François