LARGE SCALE RANDOM STRUCTURES

PROGRAM, TITLES AND ABSTRACTS

The meeting will take place in the conference room F located on the first floor of the red-bricks building in front of the Dipartimento di Matematica e Fisica. There will be eight 30-min seminars with plenty of time for questions and discussions.

1. Morning plan

- 9:15 F. Martinelli: *"Bootstrap percolation and interacting particle systems with kinetic constraints: critical time and length scales"*

- 10:00 P. Caputo: *"Random walks on sparse random networks"*

- 10:45 Coffe break

- 11:00 M. Fisher: *"On mean field games and symmetric N-player games"*

- 11:45 M. Mariani: *"Metastable asymptotic of potential theory quantities in finite-dimensions"*

- 12:30 Lunch

2. Afternoon plan

- 14:00 A. Faggionato: *"Static length scales and glassy dynamics in triangular and square plaquette models"*

- 14:45 F. Caravenna: *"Universality in marginally relevant disordered systems"*

- 15:30 D. Bertacchi e F. Zucca: *"Branching random walks and branching processes in varying environment"*

- 16:15 A. Bianchi: *"Metastability in the reversible inclusion process"*

3. ABSTRACTS

- *"Bootstrap percolation and interacting particle systems with kinetic constraints: critical time and length scales"* (F. Martinelli)

  Recent years have seen a great deal of progress in our understanding of bootstrap percolation models, a particular class of monotone cellular automata. In the two dimensional lattice $\mathbb{Z}^2$ there is now a quite satisfactory understanding of their evolution starting from a random initial condition, with a strikingly beautiful universality picture for their critical behavior. Much less is known for their non-monotone stochastic counterpart, namely kinetically constrained models (KCM). In KCM each vertex is resampled (independently) at rate one by tossing a p-coin iff it can be infected in the next step by the bootstrap model. In particular infection can also heal, hence the non- monotonicity. I shall discuss (i) some recent conjectures relating the universality behaviour of critical KCMs to their bootstrap percolation counterpart and (ii) some progresses towards proving the above conjectures.

- *"Random walks on sparse random networks"* (P. Caputo)

  I will discuss the convergence to equilibrium for some non reversible random Markov chains in random environment. The models arise as random walks on sparse random directed graphs, or on more general random networks satisfying some sparsity assumption. The main results show that the mixing time has a natural interpretation in terms of the Shannon entropy of the random walk. Moreover, the chains exhibit the so-called cutoff phenomenon, and a precise description of the cutoff window is available in various cases. Because of the nonreversible setting, part of the work concerns the identification of the nontrivial equilibrium measure. Several open problems will be discussed, such as: analysis of cover times, extension to more general Markov chains in random environment, and spectral properties of the chains.

- *"On mean field games and symmetric N-player games"* (M. Fischer)

  Mean field games, as introduced by J.M. Lasry and P.-L. Lions and, independently, by M. Huang, R.P. Malham, and P.E. Caines around 2006, are limit models for symmetric N-player games with interaction of mean field type as the number of players N goes to infinity. The aim is to provide an introduction to the topic through a simple class of finite horizon systems. We focus on the question of how to rigorously interpret the many-player limit, that is, the relationship between the mean field game and the corresponding N-player games as N gets large.

- *"Metastable asymptotic of potential theory quantities in finite-dimensions"* (M. Mariani)

  I will review some results and open problems concerning the asymptotic limit of invariant measures, and capacities for finite-dimensional diffusion processes in the small-noise limit.

- *"Static length scales and glassy dynamics in triangular and square plaquette models"* (A. Faggionato)

  We consider spin systems on Z^2 with 4-points interactions (square plaquette models) and spin systems on the triangular lattice with 3-points interactions (triangular

plaquette models). These systems evolve according to a Glauber dynamics, which is expected to show some glassy features as in suitable kinetically constrained models. We present rigorous results concerning the equilibrium properties, some relaxation time estimates and outline future research directions.

- *"Universality in marginally relevant disordered systems"* (F. Caravenna)
  We consider disordered systems for which disorder is so-called marginally relevant, including the directed polymer in random environment in dimension (2+1) and the disordered pinning model with tail exponent 1/2. We show that the partition functions of such models converge to a universal limit, in a suitable weak disorder and continuum regime. Close connections with stochastic PDEs (in particular, with the elusive two-dimensional Stochastic Heat Equation) will be described.

- *"Branching random walks and branching processes in varying environment"* (D. Bertacchi e F. Zucca)
  We discuss the state of the art by addressing some questions on the critical parameters of the branching random walk on discrete spaces (the critical parameters separate different kind of survival for the process). We apply branching random walk techniques to branching processes with reproduction law depending on the generation.

- *"Metastability in the reversible inclusion process"* (A. Bianchi)
  The inclusion process is a stochastic gas on a graph where particles perform random walks subjected to mutual attraction, thus providing the natural bosonic counterpart of the well-studied exclusion process. Due to attractive interaction between particles, the inclusion process can exhibit a condensation transition where all particles, but an infinitesimal fraction, concentrate on a single site, and a metastable transition given by the movement of the condensate between different sites. In this talk we characterize the dynamics of the condensate for the reversible inclusion process on a finite set S, in the limit of total number of particles going to infinity. By potential theoretic techniques, we determine the time-scales associated to the transitions of the condensate from one site to another, and we show that the limiting dynamics of the condensate is a suitable continuous time random walk on S.