Two days workshop on "Large scale random structures"

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ABSTRACTS

Massimo Campanino: “Estimates for the entanglement of the Ising model with transverse magnetic field in one dimension“

We consider the ground state of the one-dimensional Ising model with transverse magnetic field h in a finite interval ${\Delta_m= \{ -m, -m+1, \ldots, m+L \}}$. For H sufficiently large we prove an estimate for the entanglement in the interval $[0. L]$ relative to its complement $\Delta_m \slash [0, L]$ uniform in m and L. The estimate is obtained via a representation in a system in $\mathbb{Z} \times \mathbb{R}$ and a suitable cluster expansion.

Based on joint work with M. Gianfelice.

Francesco Caravenna: “Moment asymptotics for 2d directed polymer and stochastic heat equation in the critical window”

The partition function of the directed polymer model on Z^2 undergoes a phase transition when the disorder strength is rescaled logarithmically with the system size. In this talk we focus on a suitable window around the critical point. Exploiting renewal theorems for families of random walks with infinite mean, we determine the asymptotic behavior of the second and third moments of the partition function. This yields, as a corollary, the existence of non-trivial limits for the diffusively rescaled partition function, viewed as a random distribution on R^2. Analogous results hold for the solution of the

stochastic heat equation on R2, with multiplicative space-time white noise convoluted with a smooth kernel, in the regime of vanishing mollification and noise strength.

Based on joint works with Rongfeng Sun and Nikos Zygouras

Alekos Cecchin: " On the convergence problem in mean field games: a two state model without uniqueness"

We consider N-player games and mean field games in continuous time where the position of each agent belongs to {-1,1}. A rigorous study of the convergence of the feedback Nash equilibria to the limit is made through the so-called master equation, which in this case can be written as a scalar conservation law in one space dimension. If there is uniqueness of mean field game solutions, i.e. under monotonicity assumptions, then the master equation possesses a smooth solution which can be used to prove the convergence of the value functions of the N players and a propagation of chaos property for the associated optimal trajectories. We consider here an example with anti-monotonous cost, and show that the mean field game has exactly three solutions. We prove that the N-player game always admits a limit, which depends on the initial distribution. The value functions also converge and the limit is the entropy solution to the master equation. Moreover, viewing the mean field game system as the necessary conditions for optimality of a deterministic control problem, we show that the N-player game selects the optimum of this problem.

Alessandra Faggionato: "Large deviations and uncertainty relations in periodically driven Markov chains with applications to stochastic thermodynamics"

We will present large deviation principles for the empirical measure, flow and current of Markov chains with time-periodic jump rates. As an application we derive some Gallavotti-Cohen duality relations for the fluctuating entropy flux and we also derive trade-off relations between speed and precision for time-integrated currents. These theoretical results find applications in the thermodynamics of small systems, as biomolecular motors and molecular pumps.

(The above results have been obtained in collaboration with A.C. Barato, L. Bertini, R. Chetrite and D. Gabrielli).

Marco Formentin: “ Collective periodic behavior in the Ising model with dissipation”

We introduce a dissipated microscopic dynamics for the Ising model where the classical reversible Glauber dynamics is perturbed by adding a dissipation term. Dissipation dumps the influence of interaction when no spin-flip occurs for a long time. In the low temperature regime, the magnetization of the Ising model with dissipation displays a macroscopic regular rhythm. To our knowledge, this is the first example of rhythmic behavior for a system with local interaction.

Joint work with R. Cerf, P. Dai Pra and D. Tovazzi.

Alberto Gandolfi: “Brownian Loop Soup controlled Layering Complex Poisson Multiplicative Chaos”

We introduce, and then show the existence of, some complex random fields which are exponentials of Poisson distributed random variables. The intensity of the Poisson random variables are controlled by the mass of loops in a Brownian Loop Soup, with an additional random sign. Mathematically, the problem is analogous to that of taking the exponential of a Gaussian Free Field (in the easy, L^2 regime).

From the physical point of view, this corresponds to scattering some Brownian loops in the plane (with some appropriate cutoff), assigning a random sign to each, and then taking the complex exponential of the total sign value of the loops covering each point (i.e. having the point in their topological interior). It has relations with the theory of bubble nucleation in eternal inflation, and it gives an explicit example of primary operators in a conformal field theory. In fact, our fields (which should then be identified as the title suggests) exhibit the appropriate covariance under conformal transformations. The theory becomes free, i.e. Gaussian, for some extreme values of the parameters.

We discuss the relation with some other possible choices, such as counting the winding number of each loop instead of assigning a random sign, or scattering disks instead of Brownian loops.

This is a joint work with Federico Camia, Matthew Kleban, Giovanni Peccati, Tulasi Annapareddy.

Alfie Hlafo Mimun: “Sharp phase transition for clusters with high conductivity in the Miller-Abrahams random resistor network”

The Miller-Abrahams random resistor network is a relevant model for studying the conductivity by Mott variable range hopping in strongly disordered systems, as doped semiconductors, in the regime of strong Anderson localization and low impurity density. In this model we consider a complete graph whose vertex set is given by a homogeneous Poisson point process and we associate to each edge a random conductance. In order to compute the effective conductivity one is interested in studying percolative properties of the subgraph given by the edges with high conductivity. It is possible to show that there is a phase transition when varying the density of the point process. In particular, by using the method of randomized algorithm developed by Duminil-Copinet al. we have derived estimates for connection probabilities in the subcritical and supercritical regime.

Carlo Orrieri: “Optimal control and large deviations for interacting particle systems”

In the first part of the talk we show how to connect the optimal control of Vlasov-type PDEs with large systems of controlled interacting particles. Then we discuss a possible application of this (deterministic) limit theory to large deviations for randomly perturbed interacting particles in a joint mean-field and small-noise limit.

The talk is partly based on a joint paper with M. Fornasier, S. Lisini and G. Savaré.

Guglielmo Pelino: “Convergence, fluctuations and large deviations for finite state mean field games via the master equation”

Mean field games represent limit models for symmetric non-zero sum dynamic games when the number N of players tends to infinity. We consider games in continuous time and finite state space, where players control their transition rates from state to state. The limiting dynamics is given by a finite state Mean Field Game system made of two coupled forward-backward ODEs. We exploit the so-called Master Equation, which in this finite-dimensional framework is a first order PDE in the simplex of probability measures, obtaining the convergence of the feedback Nash equilibria, the value functions and the optimal trajectories. The convergence argument requires only the regularity of a solution to the Master Equation, which holds if there

is uniqueness of limit solutions; a sufficient condition for this uniqueness is the monotonicity assumption on the costs. Moreover, we employ the convergence method to prove a Central Limit Theorem and a Large Deviation Principle for the evolution of the N-player empirical measures.

Elisabetta Scoppola: “Shaken dynamics for the 2d Ising model”

A parallel dynamics with anisotropic interaction is introduced to study 2d Ising system at low temperature. The advantages obtained from parallelisation and anisotropy are discussed by using the associated random cluster model. Results in collaboration with R.D'Autilia and B.Scoppola.

Matteo Quattropani: “Cover time of random walks on sparse random digraphs”

he cover time is the mean time needed to cover all the states of a Markov Chain starting from the most unfavorable one. The cover time of a RW on a random graph is a random variable wrt the law of graph, and we are interested in its asymptotic behavior when the size of the graph goes to infinity. Thanks to severals works of Cooper and Freeze, the cover time is know well understood for many random (undirected) graph models. When dealing with sparse random digraphs, the invariant measure of the walk is a non trivial object. This fact makes the problem of studying the cover time much more challenging. In this brief talk I will present few recent results and some open questions.