

Timetable

	Tuesday	Wednesday	Thursday	Friday	Saturday
9:00 - 9:55		Bertini	Friz	Jara	Lacoin
10:30 – 11:25		Flandoli	Debussche	Zambotti	Luckhaus
11:30 – 12:25		Labbé	Giacomin	Dirr	den Hollander
2:00 – 2:55	Jona-Lasinio	Xu	Mourrat	Landim	
3:30 – 4:25	Funaki	Zygouras	Olla	Gonçalves	
4:30 – 5:25	Perkowski	Bodineau	Shen	Priola	

Abstracts

Tuesday:

Gianni Jona-Lasinio

On some classes of singular stochastic partial differential equations of interest in statistical mechanics

The equations of stochastic quantization, whose theory has been successfully established using recently developed powerful methods, are of gradient type and the noise is additive. A simple generalization is represented by equations in which the stochastic field has several components. These equations are generically non-gradient and the deterministic part may develop chaotic behavior. I will discuss examples for which in two space dimensions the existence of a weak probabilistic solution, in the sense of the old approach of Jona-Lasinio and Mitter, can be proved provided the gradient part dominates for large values of the field. They are expected to be also within the reach of the recent approaches. Equations arising in the so-called fluctuating hydrodynamics seem more difficult as the noise is usually multiplied by a non-linear function of the field and contain space derivatives of the noise.

Tadahisa Funaki

Coupled KPZ equation and its two types of approximations

In a joint work with Jeremy Quastel, we introduced an approximation of KPZ equation suitable for studying invariant measures, and investigated its limit due to Cole-Hopf transform. For a multi-component version of KPZ equation, a similar approximation can be introduced, but Cole-Hopf transform doesn't work. We apply paracontrolled calculus to study the limit. This is a joint work with Masato Hoshino.

Nicolas Perkowski

A martingale problem for the KPZ equation

Energy solutions provide a way of formulating the equilibrium stochastic Burgers equation as a martingale problem. They were introduced in 2010 by Gonçalves and Jara as a tool to study the equilibrium fluctuations of weakly asymmetric particle systems, but until recently it was not known whether they are unique. In this talk I will show that the stronger formulation of Gubinelli, Jara (2013) gives rise to unique solutions and apply this to study the equilibrium fluctuations of weakly asymmetric Ginzburg-Landau dynamics. Based on joint works with Joscha Diehl and Massimiliano Gubinelli.

Wednesday:

Lorenzo Bertini

Large deviations with respect to motion by curvature

Consider the Allen-Cahn equation in space dimensions $d=2$ or $d=3$. Under diffusive rescaling of space and time, for suitably prepared initial data the limiting dynamics is described by the motion by mean curvature of the interface between the two stable phases. We consider a stochastic perturbation of the Allen-Cahn equation and analyze its large deviations asymptotic in such sharp interface limit. The corresponding rate function is finite only when there exists a $d-1$ interface between the two stable phases and can be written as the sum of two terms: the first takes into account "wrong" motions of the interface while the second is due to the possible occurrence of nucleation events. Our result relies on a previous analysis on the variational convergence of the action functional associated to the Allen-Cahn equation and uses tools of the geometric measure theory.

Joint work with P. Buttà and A. Pisante.

Franco Flandoli

Mean field limit of 1-dimensional structures

Dense collections of 1-dimensional structures appear in applications, like certain biological systems and in turbulence. In the first case we have in mind the angiogenic cascade in tumor growth and we briefly discuss how to treat a simple example. Technically more demanding is the case of 3D turbulent fluids, thought as a dense collection of vortex filaments, where the direction of filaments is important. This promotes the development of a mean field theory of 1D currents - in the sense of geometric measure theory - where some initial results will be described.

Cyril Labbé

Weakly asymmetric bridges and the KPZ equation

Consider a system of N particles on a linear lattice of $2N$ sites, evolving according to the weakly asymmetric simple exclusion process, with zero-flux boundary condition at the two ends of the lattice. We provide a classification of the asymptotic behaviours of the system (invariant measure, dynamic at equilibrium, dynamic out of equilibrium) according to the asymmetry imposed to the jump rates. In particular, for a suitable choice of asymmetry, we show that the fluctuations around the hydrodynamic limit converge to the solution of the KPZ equation restricted to a finite interval of time.

Weijun Xu

Large scale behaviour of phase coexistence models

The solutions to many interesting stochastic PDEs are obtained after suitable renormalisations, which often change the original equation by a quantity that is infinity, but they do have concrete physical meanings. We will explain the meaning of the infinities in the context of the Φ_3^4 equation. As a consequence, we will see how this equation, interpreted after suitable renormalisations, arises naturally as the universal limit for symmetric phase coexistence models. We will also see how this universality can be lost when asymmetry is present.

Nikos Zygouras

High temperature limits of marginally relevant directed polymer models

We consider disordered systems of directed polymer type, for which disorder is so-called marginally relevant - a notion that appears to coincide with the notion of criticality in SPDEs. These include the usual (short-range) directed polymer model in dimension $(2 + 1)$, the long-range directed polymer model with Cauchy tails in dimension $(1 + 1)$ and the disordered pinning model with tail exponent $1/2$. We show that in a suitable high temperature and continuum limit, the partition functions of these different models converge to a universal limit: a log-normal random field with a multi-scale correlation structure, which undergoes a phase transition as the disorder strength varies. As a by-product, we show that the solution of the two-dimensional Stochastic Heat Equation with multiplicative noise, suitably regularized, converges to the same limit.

Based on joint works with Francesco Caravenna and Rongfeng Sun.

Thierry Bodineau

Perturbative regimes for deterministic dynamics of a diluted gas of hard spheres

We will consider a diluted gas of hard spheres evolving according to a Newtonian dynamics and starting close to equilibrium. We will show that in the Boltzmann Grad limit the linear and linearized Boltzmann equations can be recovered for any time.

Thursday:

Peter Friz

The enhanced Sanov theorem and propagation of chaos

We establish a Sanov type large deviation principle for an ensemble of interacting Brownian rough paths. We give also an application to propagation of chaos for a class for interacting diffusions with limit of McKean-Vlasov type.

Arnaud Debussche

The nonlinear Schrödinger equation with spatial white noise

We consider the nonlinear Schrödinger equation with a potential given by a white noise in space. We use a similar transformation as M. Hairer and C. Labbé for the 2D PAM model and the two invariant quantities of the equation to derive bounds in Sobolev space of order strictly less than 2. This allows to prove well-posedness. This is a joint work with H. Weber.

Giambattista Giacomin

On macroscopic effects of microscopic noise: phase diffusion phenomena

I will focus on the effect of additive Brownian noise on an ODE system that has a stable hyperbolic limit cycle, for initial data that are attracted to the limit cycle. The analysis is performed in the limit of small noise - that is, we modulate the noise by a small parameter ϵ - and on a long time horizon. We prove explicit estimates on the proximity of the noisy trajectory and the limit cycle up to times that are exponentially long (in $1/\epsilon^2$) and we show both that on the time scale $1/\epsilon^2$ the de-phasing (i.e., the difference between noiseless and noisy system measured in a natural coordinate system that involves a phase) is close to a Brownian motion with constant drift, and that on longer time scales the de-phasing dynamics is dominated, to leading order, by the drift. The natural choice of coordinates, that reduces the dynamics in a neighborhood of the cycle to a rotation, plays a central role and makes the connection with the applied science literature in which noisy limit cycle dynamics are often reduced to a diffusion model for the phase of the limit cycle. This basic issue in stochastic ODEs, apparently almost completely neglected by mathematicians, has received and still receives a lot of attention in bio-physics and a review of this literature will be part of the presentation.

Jean-Christophe Mourrat

Convergence of the two-dimensional Ising-Kac model to Φ^4

The Ising-Kac model is a ferromagnetic spin system where each spin has direct interaction with other spins in a large neighbourhood of itself. We study Glauber dynamics of this model, and show that for a suitable choice of parameters, the model converges to a non-linear stochastic PDE known as the Φ^4 model. Joint work with H. Weber.

Stefano Olla

Diffusive macroscopic transport in non-acoustic chains

We consider a non acoustic chain of harmonic oscillators with the dynamics perturbed by a random local exchange of momentum, such that energy and momentum are conserved. The macroscopic limits of the energy density, momentum and the curvature (or bending) of the chain satisfy, in a diffusive space-time scaling, an autonomous system of equations. The curvature and momentum evolve following a linear system that corresponds to a damped Euler-Bernoulli beam equation. The macroscopic energy density evolves following a non linear diffusive equation. In particular the energy transfer is diffusive in this dynamics. This provides a first rigorous example of a normal diffusion of energy in a one dimensional dynamics that conserves the momentum. This is also in contrast with the macroscopic behavior in acoustic chains, where there is a clear separation of scale between the relaxation to mechanical equilibrium governed by Euler equations, and to the thermal equilibrium, governed by a super diffusive fractional heat equation. (Work in collaboration with T. Komorowski).

Hao Shen

A generalization of ASEP versus a generalization of 2D dynamic Kac-Ising

Ising model and asymmetric exclusion process (ASEP) are two widely-studied models in equilibrium and non-equilibrium physics. Bertini-Giacomin proved that the scaling limit of ASEP, in the weak asymmetric regime, is KPZ. For the Ising model in 2D, Mourrat-Weber proved that its Glauber dynamics, with Kac interaction, converges to Φ^4 equation. In this talk we discuss a generalization of ASEP allowing multiple particles at each site and its convergence to KPZ. On the other hand, we consider a generalization of Kac-Ising allowing neutral spins, and show that Φ^4 is non-universal - near a tricritical point one gets Φ^6 limit. Based on joint works 1) with I. Corwin & L-C. Tsai 2) with H. Weber.

Friday:**Milton Jara***On the strong KPZ universality conjecture*

We present various results pointing out the role played by the fractional Laplacian on the behaviour of interacting particle systems at the KPZ 1:2:3 scale. Based on these results, we conjecture that the KPZ fixed point is an energy solution of a fractional KPZ equation.

Based on joint works with Cedric Bernardin (Nice), Patricia Gonalves (Lisbon), Tomasz Komorowski (Warsaw) and Stefano Olla (Paris).

Lorenzo Zambotti*Renormalisation and Taylor expansions*

One of the key steps in Regularity Structures is the renormalisation of diverging quantities. We want to describe how the complicated expressions involved in this operation can be written in a compact formula involving nested Taylor expansions of suitable integration kernels (based on joint work with Yvain Bruned and Martin Hairer)

Nicolas Dirr*Homogenization of a mean field game system in the small noise limit*

The theory of mean field games, introduced by P.-L. Lions and J.M. Lasry in 2007, describes the effective behaviour of very many rational agents, providing a rigorous microscopic justification for macroscopic models. The resulting forward-backward system of equations couples a Hamilton-Jacobi equation and a Kolmogorov-Fokker-Planck equation. This talk concerns the simultaneous effect of homogenization and of the small noise limit for a 2nd order mean field games (MFG) system with local coupling and quadratic Hamiltonian. We show under some additional assumptions that the solutions of our system converge to a solution of an effective 1st order system whose effective operators are defined through a cell problem which is a 2nd order system of ergodic MFG type. We provide several properties of the effective operators and we show that in general the effective system loses the MFG structure. Joint work with Annalisa Cesaroni and Claudio Marchi.

Claudio Landim*Static large deviations of reaction-diffusion model*

We consider an interacting particle system obtained as the superposition of a symmetric simple exclusion dynamics, speeded-up in time, with a spin-flip dynamics in a one-dimensional interval with periodic boundary conditions. We prove a large deviations principle for the empirical density under the stationary measure.

Patrícia Gonçalves

On the crossover fluctuations of the symmetric simple exclusion with a slow bond

In this talk I will describe the crossover to the Stochastic Burgers Equation at the level of the equilibrium density fluctuations of weakly asymmetric conservative systems. The key example is the symmetric simple exclusion process with a slow bond. Depending on the strength of the asymmetry we see a crossover from the Edwards-Wilkinson universality class to the KPZ universality class. This is a joint work with Tertuliano Franco (UFBA - Brazil) and Marielle Simon (INRIA - Lille, France).

Enrico Priola

Some uniqueness results for additive SDEs with jumps and Hölder continuous drift term

We present some recent uniqueness results on additive multidimensional stochastic differential equations with jumps and β -Hölder continuous drift term. We concentrate especially on SDEs driven by non-degenerate α -stable type Levy processes. We also give conditions on β and α to avoid counterexamples to uniqueness by Tanaka, Tsuchiya and Watanabe .

Saturday:

Hubert Lacoïn

The scaling limit of polymer pinning dynamics and a one dimensional Stefan freezing problem

We consider the stochastic evolution of a $1 + 1$ -dimensional interface (or polymer) in presence of a substrate. This stochastic process is a dynamical version of the homogeneous pinning model. We start from a configuration far from equilibrium: a polymer with a non-trivial macroscopic height profile, and look at the evolution of a space-time rescaled interface. In two cases, we prove that this rescaled interface has a scaling limit on the diffusive scale (space rescaled by L in both dimensions and time rescaled by L^2 where L denotes the total length of the interface) which we describe: when the interaction with the substrate is such that the system is unpinned at equilibrium, then the scaling limit of the height profile is given by the solution of the heat equation with Dirichlet boundary condition ; when the attraction to the substrate is infinite, the scaling limit is given a free-boundary problem which belongs to the class of Stefan problems with contracting boundary, also referred to as Stefan freezing problems. In addition, we prove the existence and regularity of the solution to this problem until a maximal time, where the boundaries collide.

Stephan Luckhaus

Towards a free energy for plasticity starting from many body langevin dynamics

A disclaimer: This is about a problem with no rigorous results so far. We would like to justify the set up of metal plasticity in a discrete to continuum limiting process. The proposal is to start from a Langevin many body dynamics with an energy conserving heat bath. The problem is to show in a large deviations way concentration of trajectories on local minimizers of an elastic free energy in most of space time.

Frank den Hollander

How does a charged polymer collapse?

We consider an undirected polymer chain living on the d -dimensional integer lattice and carrying i.i.d. random charges. Each self-intersection of the polymer chain contributes an energy to the interaction Hamiltonian that is equal to the product of the charges of the two monomers that meet. The joint probability distribution for the polymer chain and the charges is given by the Gibbs distribution associated with the interaction Hamiltonian. We analyze the annealed free energy per monomer in the limit as the length of the polymer chain tends to infinity.

We show that there is a critical curve in the plane of charge bias versus inverse temperature, separating an extended phase from a collapsed phase. We identify the scaling behaviour of the critical curve for small and for large charge bias, and also identify the scaling behaviour of the free energy for small charge bias and small inverse temperature.

Our proof is built on an analysis of the downward large deviations of the self-intersection local time of weakly self-avoiding simple random walk. A comparison

will be made with earlier more detailed results in $d = 1$ and conjectures will be formulated for the behaviour of the polymer chain in the two phases.

Joint work with Q. Berger, F. Caravenna, D. Ioffe, N. Petrelis, J. Poisat.