

'Gradient Models and Elasticity'

Abstracts

FRANCESCO CARAVENNA (PADOVA)

Pinning and wetting transition for (1+1)-dimensional fields with Laplacian interaction

Abstract: We consider a (1+1)-dimensional random field y_i as a model for a linear chain attracted to a flat defect line. The free law of the field is specified by the density $\exp(-\sum_i V(\Delta y_i))$ with respect to the Lebesgue measure, where Δ is the discrete Laplacian and the potential $V(\cdot)$ is fairly general. The interaction is introduced by giving the field a delta-pinning reward, weighted $\epsilon \geq 0$, each time it touches the defect line. We call this model the *pinning model*. We also consider a second model, the *wetting model*, where, in addition to the pinning reward, the field is also constrained to stay above the defect line.

We show that, as the intensity ϵ of the pinning reward increases, both models undergo a phase transition between a delocalized regime and a localized one. We prove that the transition is exactly of second order in the pinning case, while it is of first order in the wetting case. Under additional assumptions on the potential $V(\cdot)$, we also give an explicit pathwise characterization of the phase transition for the pinning model, by determining its scaling limits for all values of ϵ , including the critical one. The core of our approach is a Markov renewal theory description of the field.

JEAN-DOMINIQUE DEUSCHEL (BERLIN)

Uniqueness of gradient component for Non-Convex Gradient Models

Abstract: We consider a gradient interface model with interaction potential which is a non-convex perturbation of a convex potential. Using a technique for decoupling of the nearest neighboring vertices into even and odd vertices, we show at high temperature the uniqueness for the $\nabla\phi$ Gibbs measures, the strict convexity of the surface tension, scaling limits and decay of covariances. This is an extension of Funaki and Spohn's result, where the strict convexity of potential was crucial in their proof. The result could be applied for the derivation of the hydrodynamical limit for the Landau-Ginsburg model. Based on joint work with Codina Cotar.

GEORG DOLZMANN (REGENSBURG)

Sufficient conditions for the validity of the Cauchy-Born rule close to $SO(n)$

Abstract: The Cauchy-Born rule provides a crucial link between continuum theories of elasticity and the atomistic nature of matter. In its strongest form it says that application of affine displacement boundary conditions to a monatomic crystal will lead to an affine deformation of the whole crystal lattice. We give a general condition in arbitrary dimensions which ensures the validity of the Cauchy-Born rule for boundary deformations which are close to rigid motions.

This work generalizes results of Friesecke and Theil and is joint with S. Conti, B. Kirchheim, and S. Müller

Tadahisa Funaki (Tokyo)

Scaling limits for weakly pinned Gaussian random fields under the presence of two possible candidates

Abstract: We study the scaling limit for weakly pinned Gaussian random fields described by the gradient interface model under the critical situation that two possible candidates of the limit exist at the level of large deviation principle. In other words, our problem is to determine the Wulff shape

when the corresponding variational problem has two minimizers. The fields are defined on a box in a d -dimensional integer lattice and take values in an n -dimensional Euclidean space. In the previous work with Bolthausen and Otobe (PTRF, Online First, 2008), we considered the one-dimensional case: $d = 1$ and studied how the limits depend on n . We try to extend these results to higher dimensions: $d \geq 3$, but only when $n = 1$ and the strength of the pinning is sufficiently large.

GIACOMIN GIAMBATTISTA (PARIS)

Pinning phenomena in presence of quenched disorder

Abstract: will review the state of the art of the study of disordered pinning models and I will go more deeply into the technique, developed recently with B. Derrida, H. Lacoin and F. L. Toninelli, to get upper bounds on the partition of these models. This class of models includes the interface wetting models over disordered substrates in dimension $1+1$.

FREDERIC LEGOLL (PARIS)

Finite temperature coarse-graining of one-dimensional atomistic systems: some simple cases

Abstract: We present a possible approach for the computation of free energies and ensemble averages of one-dimensional coarse-grained models in materials science. The approach is based upon a thermodynamic limit process, and makes use of ergodic theorems and large deviation theory. We will also report on ongoing works for the 2D case. In addition to providing a possible efficient computational strategy for ensemble averages, the approach allows for assessing the accuracy of approximations commonly used in practice. This is joint work with X. Blanc (Univ. Paris 6), C. Le Bris (ENPC Paris) and C. Patz (WIAS Berlin).

PETER MÖRTERS (BATH)

Intersections of random walks in supercritical dimensions

Abstract: In high dimensions two independent simple random walks have only a finite number of intersections. In the talk I present recent progress on the problem of describing the exact upper tail behavior of random variables associated with the number of intersections. Joint work with Xia Chen.

TAKAO NISHIKAWA (TOKYO)

The large deviation for the Ginzburg-Landau $\nabla\phi$ interface model with a conservation law

Abstract: The nonlinear fourth-order partial differential equation is derived from for the Ginzburg-Landau $\nabla\phi$ interface model with a conservation law as the macroscopic equation in [N. 2002]. Regarding it as the law of large numbers, we shall consider the large deviation corresponding to above. Since we do not have the characterization of extremal stationary measures (extremal Gibbs measures are completely characterized), we can obtain the large deviation and the exact form of the rate functional in the case that the dimension is two or three only.

GRIGORIS PAVLIOTIS (IMPERIAL LONDON)

From ballistic to diffusive behaviour in periodic potentials

Abstract: In this talk we will present some recent results on the long-time/large-scale, small-friction asymptotic for the Langevin equation with a periodic potential. We show that the Freidlin-Wentzell and central limit theorem (homogenization) limits commute. We prove that, in the combined small friction, long-time/large-scale limit the particle position converges weakly to a Brownian motion with a singular diffusion coefficient which we compute explicitly. We show that the same result is valid for a whole one parameter family of space/time rescalings. The proofs of our main results are based on some novel estimates on the resolvent of a hypoelliptic operator.

OLIVER PENROSE (EDINBURGH)

Statistical mechanics of nonlinear elasticity for interacting hard disks

Abstract: The model considered is a two-dimensional system of hard disks, with or without an attractive short-range interaction. A ‘constrained free energy’ is defined, using the standard configurational integral of statistical mechanics subject to two constraints which relate the set of configurations we integrate over to a given close-packed reference configuration of the set of disks under consideration. These constraints are: (i) if two disks are nearest neighbours in the close-packed reference configuration, then their separation is constrained to be less than $\sqrt{2}$ times the disk diameter and (ii) each disk at the boundary of the reference configuration are constrained to stay within a specified distance from a specified point or points in the wall material. It is shown that, if the anchor points of the boundary particles are related to their reference positions by a constant deformation matrix \mathbf{A} belonging to a certain set \mathcal{A} , then the free energy per particle, related to the partition function in the usual way, has a well-defined thermodynamic limit. (The set \mathcal{A} comprises all 2×2 matrices which when applied to the reference configuration produce a configuration that is compatible with the constraint (i) and also with the condition that disks must not overlap.) It is also shown that the free energy per particle is a continuous quasi-convex function of the matrix \mathbf{A} , within its domain of definition.

HERBERT SPOHN (MUNICH)

Kinetic theory of the weakly nonlinear Schroedinger equation

Abstract: I report on joint work with J. Lukkarinen. We consider the nonlinear Schroedinger equation on a lattice in dimension greater or equal than 3 and study the $\psi - \psi$ time correlation in thermal equilibrium. We prove the convergence of the kinetic limit and identify the limiting correlation. Our technique is an extension of the diagrammatic method by Erdős and Yau to the weakly nonlinear setting.

DIMITRIOS TSAGKAROGLIANNIS (MAX PLANCK LEIPZIG)

Minimal cost for the forced displacement of an interface

Abstract: We study the probability of the motion of an interface between two stable phases of a ferromagnetic system from an initial to a final position within fixed time. We work with a stochastic microscopic system of Ising spins with Kac interaction evolving in time according to the Glauber (non-conservative) dynamics. We derive the cost functional penalizing all possible transitions and we minimize it to find the most probable profile which corresponds to the motion of the interface in the macroscopic scale. This is joint work with N. Dirr and G. Manzi.

FLORIAN THEIL (WARWICK)

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Abstract:

AERNOUT VAN ENTER (GRONINGEN)

First-order transitions in the presence of continuous symmetries or Non-existence of gradient Gibbs measures for some disordered surface models

Abstract: We discuss some examples of two-dimensional models which not only have no Gibbs measures, but even lack a gradient Gibbs measure. In other words, not only the height, but also the tilt of the surface has too large fluctuations for existence.

JOHANNES ZIMMER (BATH)

From conservative lattice models for elasticity to macroscopic dissipation

Abstract: We consider travelling waves in a one-dimensional chain of atoms with nearest neighbour interaction. The elastic potential is piecewise quadratic and the model is thus capable of describing phase transitions. We show that for suitable fixed subsonic waves, there is a family of “heteroclinic”

travelling waves (connecting both wells of the energy). Though the microscopic picture is Hamiltonian, we show that on the macroscopic scale, there are non-trivial so-called kinetic relations, which can be related to the dissipation generated by a moving phase boundary.