Abstracts

Some exponents related to the geometry of the Airy sheet

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ABSTRACT

The space time Airy sheet is a four parameter (time co-ordinates s¡t and spatial co-ordinates x,y) random field that is conjectured to be, after a parabolic adjustment, the universal weak limit of scaled polymer weights between points with scaled co-ordinates (x,s) and (y,t) in a large class of (1+1)-dimensional zero temperature polymer models. This central object in the KPZ universality class has very recently been constructed in a breakthrough work of Dauvergne, Ortmann and Virag. There has also been ongoing parallel efforts in studying the geometry of polymer weight profiles in pre-limiting exactly solvable models of last passage percolation to glean information on the geometry of the space time Airy sheet. In this talk, we shall discuss two recent results in this vein. The first result, in the context of last passage percolation with exponential weights, gives exponents governing the decay of correlation at the time direction at short and large scales. The second result, started with the pre-limiting model of Brownian last passage percolation, studies the fractal geometry of difference of scaled polymer weight profiles at time 1 started at distinct points at time 0. This, in the weak limit, up to the addition of a linear function, is the difference of two Airy_2 processes coupled non-trivially via the airy sheet. We show that the difference is locally constant almost everywhere and determine the almost sure Hausdorff dimension of the set of exceptional points where it is not.

The two dimensional random field Ising model

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ABSTRACT

In this talk we discuss the magnetisation field of the two dimensional critical Ising model with disorder. Since its introduction by Lenz in 1920, the Ising model has been one of the most studied statistical mechanics models. It has been particularly central in the theory of critical phenomena since Peierls famously proved that it undergoes a phase transition at a critical temperature. It was shown by Aizenman and Wehr in 1990 that, under the application of a small random external field, such a phase transition ceases to exist. We tune the strength of the random field suitably with the mesh size so that the magnetisation field admits a disordered continuum limit and study its properties in relation to the continuum limit without disorder.

CLT for point processes with fast decay of correlations

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ABSTRACT

We shall summarize some recent progress on proving central limit theorems for quasi-local statistics for point processes with fast decay of correlations. In the talk, we shall consider the underlying space for the point process to be either Euclidean or Cayley graphs but shall try to hint at extensions to more general spaces. Fast decay of correlations is weaker than many mixing conditions for point processes in the literature and is satisfied by many point processes. Quasi-locality will be quantified by what is known as 'stabilizing radius'. We will show that under suitable tail assumptions on 'stabilizing radius', fast decay of correlations, growth condition on balls in the underlying space and variance lower bounds, one can prove a CLT for quasi-local statistics of point processes. The proof technique is via controlling mixed moments and thereby bounding the cumulants also allows for surface-order variance growth. Some point processes have surface-order variance growth and hence this flexibility with the variance growth is important. We will briefly mention some applications to statistics of spatial unimodular random graph models and also discuss possible extensions. This is based on joint works with B. Blaszczyszyn, J. E. Yukich, S. Vadlamani and Tulasi Ram Reddy.

Brownian loops and imaginary multiplicative chaos

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ABSTRACT

We consider, and show the existence of, some complex valued random fields which are obtained by scattering Poisson distributed loops endowed with symmetric random variables; the fields of interest are then the suitably rescaled exponentials of sums of such random variables. Poisson intensities are taken either from a disk model, or, more interestingly, from, massive or massless, Brownian Loop Soup. The model is analogous to the so called Complex Gaussian Multiplicative Chaos (CGMC), which is instead based on exponentials of sums of Gaussian variables.

In the seminar we review the various models, motivating their definitions in terms of conformal field theories, eternal inflation, turbulence etc.; we then discuss similarities and differences, and show that the Poisson based fields converge to their Gaussian counterpart only in the limit of high Poisson intensity. Such limit determines a CGMC which is conformal covariant but, quite surprisingly, different from the standard one based on the Gaussian Free Field.

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

Scaling limit of semiflexible polymers: a phase transition

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ABSTRACT

In this talk we consider interface models with a mixed gradient and Laplacian interaction. The strength of the two operators are governed by parameters called lateral tension and bending rigidity and they might depend on the size of the graph. In this article we show a phase transition in the limit according to the strength of these parameters: we prove that the scaling limit is, respectively, a Gaussian free field, a "mixed" random distribution and the continuum membrane model in three different regimes. The talk is based on a joint work with Alessandra Cipriani (TU Delft) and Biltu Dan (ISI, Kolkata).

Exponential decay in the near-critical planar Ising model

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ABSTRACT

We consider the two-dimensional Ising model at its critical temperature with small magnetic field. We show that the correlations in this model decay exponentially with a rate independent of the lattice spacing. We also show exponential decay in the scaling limit of this near-critical model. This is joint work with Federico Camia and Chuck Newman.

Near-critical percolation with heavy-tailed impurities

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ABSTRACT

Consider a "nice" planar lattice, such as the square or the triangular lattice. We introduce a new percolation model, defined as follows. First, regions ("impurities") are removed from the lattice, in some independent fashion, and we then consider site percolation on the remaining vertices. The mentioned impurities are not only microscopic, but also allowed to be mesoscopic ("heavy-tailed", in some sense).

We are typically interested in whether, on the randomly "perforated" lattice, the connectivity properties of percolation remain of the same order as without impurities, for values of the percolation parameter close to the critical value. We determine explicitly the range of parameters in the distribution of impurities for which it is indeed the case, for distances below a certain characteristic length. This is a substantial generalization of a celebrated result by Kesten for classical near-critical percolation (that we view as critical percolation with single-site impurities): the fact that large parts of the lattice are removed makes the proofs quite subtle.

This generalization, which is also of independent interest, arises naturally when studying models of forest fires (or epidemics). Our results for percolation with impurities are instrumental in analyzing the behavior of such processes near and beyond the critical time (i.e. the time after which, in the absence of fires (epidemics), infinite connected components would emerge).

This talk is based on a joint work with Rob van den Berg (CWI and VU, Amsterdam).

Criticality and covered area fraction in confetti and Voronoi percolation

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ABSTRACT

Using the randomized algorithm method developed by Duminil-Copin, Raoufi, Tassion (2019b) we exhibit sharp phase transition for the confetti percolation model. This provides an alternate proof that the critical parameter for percolation in this model is 1/2 when the underlying shapes for the distinct colours arise from the same distribution and extends the work of Hirsch (2015) and Müller (2016). In addition we study the covered area fraction for this model, which is akin to the covered volume fraction in continuum percolation. Modulo a certain 'transitivity condition' this study allows us to calculate exact critical parameter for percolation when the underlying shapes for different colours may be of different sizes. Similar results are also obtained for the Poisson Voronoi percolation model when different coloured points have different growth speeds.

This is joint work with Partha Pratim Ghosh.

Forest fires and near-critical percolation

Rob van den Berg

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ABSTRACT

In this talk I discuss recent joint work with Pierre Nolin on models of forest fires and related processes. In these models, all vertices of a lattice are initially vacant, and then become occupied (by a tree) at rate 1. If a tree is hit by lightning, which occurs at a rate much smaller than 1, its entire occupied cluster burns immediately. It turns out that these models have a surprising behavior near and beyond the critical time (i.e. the time after which, in a model without fires, an infinite cluster emerges). In particular we prove the existence of a sequence of "exceptional length scales". Crucial for the proof are new results for near-critical percolation with "heavy-tailed" impurities.