Titles and Abstracts

Polynomial rate of convergence of critical interfaces to SLE curves

Ilia Binder (Toronto)

Abstract: In this talk, we will focus on the rate of convergence of critical interfaces of di erent lattice models to SLE. We will cover a general framework for establishing polynomial rates of convergence. As an example, we will examine the exploration process for critical percolation. We will discuss the fact that for any "reasonable" critical percolation model, the convergence of the exploration process is established and the polynomial rate of convergence must automatically hold. This result is unconditional for the critical site percolation on the hexagonal lattice and some of its generalizations, which will be discussed during the talk. Additionally, we will talk about applications of this framework to other models such as Harmonic Explorer and the Ising model. This talk is based on joint projects with L. Chayes, H. Lei, and L. Richards.

Large deviations for the capacity of the Wiener sausage

Erwin Bolthausen (U. Zurich)

Abstract: The capacity C_t of the standard Wiener sausage of time length t in dimensions $d \geq 5$ is typically of order $c_d t$ where c_d is a not explicitly known constant. In dimension 4, there is a logarithmic correction. We derive a variational formula for the probability that $C_t \leq bt$ where $b < c_d$, in dimension 5 and above.

This is joint work with Michiel van den Berg (Bristol, UK), and Frank den Hollander (Leiden, NL).

Conditioned branching random walk and related problems

Xinxin Chen (Beijing Normal Univ.)

Abstract: We consider a supercritical branching random walk on the real line in the so called -case where the whole system a.s. goes to $+\infty$ eventually, and the additive martingale converges a.s. and in mean to some non-degenerate random variable W_1 under suitable moment condition. We consider the joint tail of the global minimum and W_1 , and with the help of it, we study the branching random walk conditioned on

atypically small global minimum or conditioned on large W_1. We will also study the biased random walk in random environment which is given by this branching random walk and talk about some related results. This is based on a joint work with L. de Raphelis.

Limit law for Brownian cover time of the two-dimensional torus

Amir Dembo (Stanford)

Abstract: Consider the time $C(r)$ it takes a Brownian motion to come within distance r of every point in the two-dimensional torus of area one. I will discuss the key ideas in a joint work with Jay Rosen and Ofer Zeitouni, showing that as r goes to zero, the square-root of $C(r)$, minus an explicit non-random centering $m(r)$, converges in distribution to a randomly shifted Gumbel law.

Gibbs measure dynamics in nonlinear dispersive equations

Yu Deng (USC)

Abstract: The Φ^4, and generally Φ^p measures, which are extensively studied in quantum field theory, also occur naturally as invariant Gibbs measures for certain (dispersive) Hamiltonian PDEs and parabolic SPDEs. A fundamental question is to rigorously justify the invariance of such measures under said dynamics, which leads to deep questions in the solution theory of random data and stochastic PDEs. In this talk we review some recent progress in the dispersive setting, including the proof of invariance of Φ^p_2 under Schrodinger dynamics and of Φ^4_3 under wave dynamics. In the Schrodinger case, we also obtain local well-posedness results in the full probabilistically subcritical regime. These are joint works with Bjoern Bringmann, Andrea R. Nahmod and Haitian Yue.

Interface motion from non-gradient Glauber-Kawasaki dynamics

Tadahisa Funaki (BIMSA)

Abstract: We consider Glauber-Kawasaki dynamics of non-gradient type and derive, under a hydrodynamic scaling limit, a new type of interface motion, that is, a direction-dependent curvature flow. This extends a series of our recent results shown under the gradient condition, in which mean-curvature flow or Huygens' principle was derived.

Fluctuations of the Discrete Gaussian Chain

Christophe Garban (Lyon)

Boundary limits for the six-vertex model

Vadim Gorin (UC Berkeley)

Abstract: Take a random configuration of $(a; b; c)$-weighted six-vertex model in a very large planar domain. What does it look like near a straight segment of the boundary? We investigate this question on the example of the model in $N \times N$ square with Domain Wall Boundary Conditions and find that the answer depends on the value of $\Delta = (a^2 + b^2 - c^2)=(2ab)$: there is a single universal limiting object for all $\Delta < 1$ and a richer class of limits at $\Delta > 1$.

Scaling limits of 1D stochastic transport diffusion equations

Martin Hairer (EPFL & Imperial)

Uniqueness of the critical long-range percolation metrics

Lujing Huang (Fujian Normal Univ.)

Abstract: In this work, we study the random metric for the critical long-range percolation on $\mathbb{Z}^d$. A recent work by Bäumler implies the subsequential scaling limit, and our main contribution is to prove that the subsequential limit is uniquely characterized by a natural list of axioms. Our proof method is hugely inspired by recent works of Gwynne and Miller, and Ding and Gwynne on the uniqueness of Liouville quantum gravity metrics.

Mean field dynamics and related nonlocal PDEs

Juan Li (Shandong Univ.)

Abstract: In the recent years, motivated by the pioneering paper by Lasry and Lions (2007) and the works on mean eld backward stochastic di erential equations by Buckdahn, Peng and Li (2009), nonlocal partial di erential equations (PDEs) and stochastic PDEs over Wasserstein spaces have found a special interest. In this talk we will present di erent types of such nonlocal PDEs of mean eld and their stochastic interpretation through splitting forward and backward mean eld SDEs. Based on joint works with Rainer Buckdahn (UBO, France), Tao Hao (SUFE, China), Shige Peng (SDU, China), Catherine Rainer (UBO, France), Chuanzhi Xing (SDU, China).

Addressing long-range correlations in stochastic equations

Xue-Mei Li (EPFL & Imperial)

Abstract: In this talk, we discuss the intriguing problem of incorporating and e ectively utilizing long-range correlated noise within the framework of stochastic di erential equations (SDEs) and stochastic partial di erential equations (SPDEs). The ability to harness long-range correlated noise is undeniably crucial across a diverse spectrum of applications, spanning hydrology, image processing, economics, and nance. Despite the signi cant attention garnered by long-range correlated noise, there remains a surprising paucity of progress within the equation framework.

Our discussion will cover both temporal and spatial correlations. We will explore suitable techniques and present results pertaining to coarse-grained scaling uctuations and large-time dynamics.

Solids and liquids: new results on the low temperature SOS model

Eyal Lubetzky (NYU Courant)

Abstract: We will review the picture for the $(2 + 1)$D Solid-On-Solid (SOS) model at low temperature in di erent settings (boundary conditions, walls, external elds), focusing on recent progress in understanding its static and dynamical features.

Mathematics of complex streamed data

Terry Lyons (Oxford)

Brownian Excursions, Ising Models and the Riemann Hypothesis Possible Connections

Chuck Newman (NYU Courant)

Abstract: The distribution of the maximum of a Brownian excursion (BE), known explicitly since 1976, is related to the Riemann zeta and ksi functions. We discuss how if one could properly relate either ksi or BE to an Ising model (IM), the Riemann Hypothesis would follow from the 1952 theorem of Lee and Yang about zeros of IM partition functions.

Convection-enhanced diffusion in a critical case

Felix Otto (MPI Leipzig)

Abstract: We consider a di usion process with a random time-independent and spatially stationary drift. The two-dimensional case is scaling-wise critical; we focus on a divergence-free drift,which can be written as the curl of the Gaussian free eld.In the presence of an unavoidable small-scale cut-o , we prove that the process is borderline super-di usive: Its annealed second moments grow like $t\sqrt{\ln t}$. This re nes a recent result of Cannizzaro, Haunschmid-Sibitz and Toninelli; the method however is completely di erent and appeals to quantitative stochastic homogenization of the generator that can be reformulated as a divergence-form second-order elliptic operator. In fact, it embeds homogenization techniques into a renormalization group argument reminiscent of the heuristics in the physics literature.

This is joint work with Georgiana Chatzigeorgiou, Peter Morfe, and Lihan Wang.

Vertex-removal stability and the least positive value of harmonic measures

Eviatar Procaccia (Technion)

Abstract: We prove that for Z^d ($d > 1$), the vertex-removal stability of harmonic measures (i.e. it is feasible to remove some vertex while changing the harmonic measure by a bounded factor) holds if and only if d=2. The proof mainly relies on geometric arguments, with a surprising use of the discrete Klein bottle. Moreover, a direct application of this stability veri es a conjecture of Calvert, Ganguly and Hammond, for the exponential decay of the least positive value of harmonic measures on Z^2. Furthermore, the analogue of this conjecture for Z^d with $d > 2$ is also proved in this paper, despite vertex-removal stability no longer holding.

Conformally invariant fields out of Brownian loop soups

Wei Qian (City U. Hong Kong)

Abstract: For each central charge $c \in (0,1]$, we construct a conformally invariant field which is a measurable function of the local time field $\mathcal{L}$ of the Brownian loop soup with intensity c and i.i.d. signs given to each cluster. This field is canonically associated to $\mathcal{L}$, in a sense which is similar to the isomorphism theory that associates the Gaussian free field to the loop soup with critical intensity. Isomorphisms between Brownian motions and random fields were previously developed by Symanzik, Brydges-Fröhlich-Spencer, Dynkin and Le Jan in several different settings.

We also extend the coupling between CLE(4) and GFF for all $\kappa \in (8/3, 4]$. We show that the (non-nested) CLE loops form level lines for this field and that there exists a constant height gap between the values of the field on either side of the CLE loops.

This talk is based on joint works with Antoine Jego (EPFL) and Titus Lupu (CNRS).

Coulomb gas and compactified imaginary Liouville theory

Remi Rhodes (Marseille)

Abstract: Conformal Field Theories (CFT) play a central role in the description of statistical physics models undergoing a second order phase transition at their critical point. The recent development of the Liouville CFT, which is the scaling limit of random planar maps, has shed some light on the mathematical structure of CFT and has had many applications regarding the derivation of exact formulae for various statistical physics models. In this talk I will present the probabilistic construction of another important CFT, called imaginary Liouville CFT, and explain why it satisfies the axioms of CFT, in particular Segal's gluing axioms. In physics this path integral is conjectured to describe the scaling limit of critical loop models such as Q-Potts or $O(n)$ models. This CFT has several exotic features: most importantly, it is non unitary and has the structure of a logarithmic CFT. Therefore it provides a playground for the mathematical study of these concepts.

Percolation and the phase transition for the vacant set of random walk

Pierre-Francois Rodriguez (Imperial)

Abstract: The vacant set of the random walk on the torus is known to undergo a percolation phase transition at Poissonian timescales in dimensions 3 and higher. The talk will discuss recent progress regarding the nature of the transition, both for this model and its infinite-volume limit, the vacant set of random interlacements, introduced by Sznitman in Ann. Math., 171 (2010), 2039–2087. The discussion will lead up to recent progress regarding the long purported equality of several critical parameters naturally associated to this phase transition.

Boundary conditions and universal finite-size scaling in high dimensions

Gordon Slade (UBC)

Abstract: Above the upper critical dimension, boundary conditions play a dramatic role in nite-size scaling for spin systems and related models, as has been widely discussed in the physics literature. We present recent work (joint with Emmanuel Michta and Jiwoon Park arxiv:2306.00896) which provides a thorough and precise account of the e ect of free vs periodic boundary conditions on the universal nite-size scaling of the weakly coupled hierarchical $| ' |^4$ spin system in dimensions 4 and higher, and o ers precise conjectures for other spin systems and self-avoiding walk in high dimensions.

Transience for the interchange process in dimension 5

Allan Sly (Princeton)

Abstract: The interchange process $_T$ is a random permutation valued process on a graph evolving in time by transpositions on its edges at rate 1. On Z^d, when T is small all the cycles of the permutation $_T$ are nite almost surely. In dimension $d \geq 3$ in nite cycles are expected when T is large. The cycles can be interpreted as a random walk which interacts with its past and we give a multi-scale proof establishing transience of the walk (and hence in nite cycles) when $d \geq 5$. In a nite volume we establish Poisson-Dirichlet statistics for the largest cycles. Joint work with Dor Elboim.

Noncommutative continuous differentially subordinate martingales and second order Riesz transforms

Lian Wu (Central South Univ.)

Abstract: We introduce the notion of di erential subordination for noncommutative continuous martingales and show that for $2 < p < \infty$ the domination enforces the corresponding L^p bound between the two processes. As an application, we obtain best-oder L^p inequalities for second-order Riesz transforms on group von Neumann algebra.

Connection probabilities for Ising model and their relation to Dyson's circular ensemble

Hao Wu (Tsinghua)

Abstract: Conformal invariance of critical lattice models in two-dimensional has been vigorously studied for decades. In this talk, we focus on connection probabilities for Ising model.

This talk has two parts. In the rst part, we consider critical Ising model and give the connection probabilities of multiple interfaces. Such probabilities are related to solutions to BPZ equations in conformal eld theory. In the second part, we explain a relation between multiple Ising interfaces and Dyson's circular ensemble.

Surface quasi-geostrophic equation perturbed by derivatives of space-time white noise

Xiangchan Zhu (Chinese Academy of Sciences)

Abstract: We consider a family of singular surface quasi-geostrophic equations

$$\partial_t \ + u \cdot \nabla \ = - \ (- \ )^{\gamma/2} \ + (- \ )^{\alpha/2} \ ; \qquad u = \nabla^{\perp}(- \ ) \ ^{1/2} \ ;$$

on $[0,\infty) \times \mathbb{T}^2$, where $\ \geq 0$, $\ \in [0,3/2)$, $\ \in [0,1/4)$ and is a space-time white noise. For the rst time, we establish the *existence of infinitely man o t e is*