Titles and Abstracts

Phase transition for the smallest eigenvalue of covariance matrices

Zhigang Bao(鲍志刚)
Hong Kong University of Science and Technology

In the study of extreme eigenvalues of Wigner matrices and the largest eigenvalue of sample covariance matrices, it has been established that a weak 4th moment condition is necessary and sufficient for the Tracy-Widom law to hold. In this talk, we will show that the Tracy-Widom law is more robust for the smallest non-zero eigenvalue of the sample covariance matrix. We will specifically illustrate a phase transition from the Tracy-Widom distribution to a Gaussian distribution when the tail exponent of the matrix entry distribution crosses the value of 8/3. This talk is based on a joint work with Jaehun Lee and Xiaocong Xu.

Littlewood-Offord problems for Curie-Weiss models

Yinshan Chang(常寅山)
Sichuan University

Classical Littlewood-Offord problems concern the upper bound of the probability that certain linear combination of Rademacher series belongs to certain interval. In 1D case, the first result appears in the study of real roots of random polynomials by Littlewood and Offord. We replace independent Rademacher series by dependent spins in Curie-Weiss models, and obtain analogous results. In our results, we observe the phenomeno of phase transition. Besides, we also consider analogous problems for general ferromagnetic Ising models.

Conditioned branching random walk and related problems

Xinxin Chen(陈昕昕)
Beijing Normal University

We consider a supercritical branching random walk on the real line in the so called κ-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_∞ under suitable moment condition. When $\kappa=1$, we are in the boundary case where the additive martingale needs to be replaced by derivative martingale D_∞. We study the asymptotical behaviors of the branching random walk conditioned on large W_∞ (or D_∞). We will also discuss several related problems on martingale limits and conditioned laws. This is based on joint works with L. de Raphelis and with B. Mallein.

Uniqueness of the critical long range percolation metrics

Zherui Fan(范哲睿)
Peking University

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. This is based on a joint work with Jian Ding and Lu-Jing Huang.

High-temperature cluster expansion for quantum spin lattice systems

Roberto Fernandez
Utrecht University (Emer.) and NYU Shanghai

We develop a novel cluster expansion for finite-spin lattice systems subject to multi-body quantum ---and, in particular, classical--- interactions. Our approach is based on the use of the Mobius transform instead of the usual ``± 1 trick", introduced by Mayer. Our treatment is inspired by work by Park, but leads to explicit expansions in a β-dependent effective fugacity, instead of a Kirwood-Salzburg system of equations. The resulting series provide an explicit perturbative evaluation of free energy and correlation functions at small β which leads to improved estimations of their range of analyticity. Jointly with Nguyen Tong Xuan (NYU Shanghai).

Introduction to a probabilistic approach to the Toda conformal field theory

Yichao Huang(黄逸超)
Beijing Institute of Technology

We review a probabilistic approach to the study of the Toda conformal field theory based on the theory of Gaussian Multiplicative Chaos. While this is an extension of a probabilistic approach to the Liouville conformal field theory developed by David-Guillarmou-Kupiainen-Rhodes-Vargas and collaborators, some novelties and difficulties arise. I will mainly focus on the definition of the Toda conformal field theory and the derivation of certain new and simple formulas (not recorded in the physics literature) allowing us to rediscover certain key differential equations recorded by Fateev-Litvinov. If time permits, I will briefly comment on the difficulties of extending integrability results to the Toda case.

Phase transitions of the graphical representations of the Ising model

Frederik Ravn Klausen
University of Copenhagen

After much success in using the double random current representation in the study of the Ising model, Duminil-Copin posed the question in 2016 of determining the (percolative) phase transition of the single random current. By relating the single random current to the loop O(1) model, we prove polynomial lower bounds for path probabilities (and infinite expectation of cluster sizes) for both the single random current and loop O(1) model corresponding to any supercritical Ising model on the hypercubic lattice. Thereby partially resolving the posed question.

In this talk, I will gently introduce graphical representations of the Ising model and their relations through the uniform even subgraph. Afterward, we discuss new results whose surprising proof takes inspiration from the toric code in quantum theory.

Based on joint work with Ulrik Tinggaard Hansen and Boris Kjær:
https://arxiv.org/abs/2306.05130.

Random matrix and Brownian motion

Xiangdong Li(李向东)
Chinese Academy of Sciences

Random matrix theory can be tracked back to the works of Wishart and Hsu in 1930s, and has been received intensive study after Wigner proved the semi-circle law. In the 1960s, F. Dyson found the relationship between the Hermitian or real symmetric random matrices and Brownian motion. In this talk, I will first review the works of Wigner and Dyson, then I will present some of our recent results on the LLN and CLT for the Generalized Dyson Brownian motion.

Convergence of contour functions of conditioned Galton-Watson trees

Xiaodan Li(李晓丹)
Shanghai University of Finance and Economics

The conditional law of Brownian motion given its local time process was first characterized by Warren and Yor through a space-time transformation of the burglar and by Aldous through a time-changed Kingman's coalescent. Then we are motivated to study this kind of conditioned Brownian motion based on the correspondence between trees and continuous functions. In this talk, we will show the contour functions of Galton-Waston trees with immigration conditioned on their size at each generation converge to the conditioned Brownian motion, which is a self-repelling diffusion investigated by Aidekon, Hu, Shi and Lupu, Sabot, Tarres. This talk is based on a joint work with Chengshi Wang and Yushu Zheng.

Low-Degree Hardness of Detection for Correlated Erd\H{o}s-R\'enyi Graphs

Zhangsong Li(李章颂)
Peking University

Given two Erd\H{o}s-R\'enyi graphs with n vertices whose edges are correlated through a latent vertex correspondence, we study complexity lower bounds for the associated correlation detection problem for the class of low-degree polynomial algorithms. In this talk we provide evidence that this class of algorithms fails for detection under certain conditions. Our result suggests that several state-of-the-art algorithms on correlation detection and exact matching recovery may be essentially the best possible. Based on a joint work with Jian Ding and Hang Du.

On the duality between height functions and continuous spin models

Marcin Lis
Vienna University of Technology

We revisit the classical phenomenon of duality between random integer-valued height functions with positive definite potentials and abelian spin models with O(2) symmetry. We use it to derive new results in quite high generality including: a universal upper bound on the variance of the height function in terms of the Green's function (a GFF bound) which among others implies localisation on transient graphs; monotonicity of said variance with respect to a natural temperature parameter; the fact that delocalisation of the height function implies a BKT phase transition in planar models; and also delocalisation itself for height functions on periodic ``almost'' planar graphs. This is joint work with Diederik van Engelenburg.

Chasing two problems in information theory

Chandra Nair
The Chinese University of Hong Kong

This talk will highlight instances where chasing to solve two open problems in information theory has led to new insights and techniques of broader interest. The open problems are related to determining the capacity regions in two central instances. Progress on these questions has led to the development of interesting new techniques and proof ideas. The talk will highlight the techniques and ideas and present a conjecture that goes beyond the two open problems.

Bulk deviation lower bounds for the simple random walk

Maximilian Nitzschner
Hong Kong University of Science and Technology

In this talk we present large deviation lower bounds for the probability of certain bulk-deviation events depending on the occupation-time field of a simple random walk on the Euclidean lattice in dimensions larger or equal to three.

As a particular application, these bounds imply an exact leading order decay rate for the probability of the event that a simple random walk covers a substantial fraction of a macroscopic body, when combined with a corresponding upper bound previously obtained by Sznitman. As a pivotal tool for deriving such optimal lower bounds, we recall the model of tilted walks which was first introduced by Li in order to develop similar large deviation lower bounds for the probability of disconnecting a macroscopic body from an enclosing box by the trace of a simple random walk. We then discuss a refined local coupling with the model of random interlacements which is used to locally approximate the occupation times of the tilted walk. Based on joint work with A. Chiarini (University of Padova).

Granular and Asynchronous DeGroot Dynamics

Ron Peretz
Bar-Ilan University

MH DeGroot (1974) proposed the following model of opinion dynamics: nodes of a graph hold real-valued opinions. At discrete periods, the nodes simultaneously update their opinions by replacing their current opinion with the (possibly weighted) average of the opinions of their neighbor. We study two variations of Degoot's model: the m-granular and the asynchronous DeGroot dynamics. In the m-granular variation, opinions are rounded to the nearest integer multiples of 1/m with one's own opinion serving as a tiebreaker. In the asynchronous variation, the nodes update their opinions at the rings of iid Poisson clocks on the nodes.

Two features that are well-known to hold in the classic model are shown to hold in the variations: the conversion of opinions and the (approximate) consensus of limiting opinions. In the m-granular variant, we focus on its robustness to the presence of stubborn agents, nodes who never update their opinion. In the asynchronous variant, we attain sharp estimates of the convergence rate and the variance of the limit consensual opinion.

The talk is based on two joint papers:

Gideon Amir, Itai Arieli, Galit Ashkenazi-Golan, and Ron Peretz. "Granular DeGroot Dynamics--a Model for Robust Naive Learning in Social Networks." In Proceedings of the 23rd ACM Conference on Economics and Computation, pp. 323-324. 2022.

Dor Elboim, Yuval Peres, and Ron Peretz. "The Asynchronous DeGroot Dynamics." arXiv preprint arXiv:2209.05764 (2022).

Recurrence and Transience of Multidimensional Elephant Random Walks

Shuo Qin(秦硕)
NYU Shanghai

The elephant random walk has generated much interest in the recent years. We prove a conjecture by Bertoin that the multidimensional elephant random walk (MERW) on the d-dimensional lattice is transient if $d \geqslant 3$. In dimensions d=1, 2, we prove that phase transitions between recurrence and transience occur at $p=(2d+1)/(4d)$, which closes the question on the transience and recurrence of MERWs.

Plane Partitions, Pedestals, Tsetlin Libraries, Pop Shuffles, Left-Regular Bands And The Miracle of Integer Eigenvalues

Senya Shlosman
Skoltech Center of Advance Studies

I will discuss a class of matrices with polynomial entries, which have polynomial eigenvalues.

This is joint work with Richard Kenyon, Maxim Kontsevich, Oleg Ogievetsky, Cosmin Pohoata and Will Sawin.

The reference：http://arxiv.org/abs/2401.05291

Several results on hard-core models

Yuri Suhov
Pennsylvania State University

Hard-core models have applications and attract attention in a number of areas. I will report some results on both classical and quantum hard-core models and discuss various aspects: algebraic, geometric. combina-torial and probabilistic. The talk will not assume any preliminary knowledge apart from basic concepts of Probability theory and Functional Analysis.

Diameter of Random Spanning Trees in Random Environment

Rongfeng Sun(孙嵘枫)
National University of Singapore

We introduce a new spanning tree model which we call Random Spanning Trees in Random Environment (RSTRE). As the inverse temperature \beta varies, it interpolates between the uniform spanning tree and the minimum spanning tree. On the complete graph with n vertices, we show that with high probability, the diameter of the random spanning tree is of order n^{1/2} when \beta =o(n/log n), and is of order n^{1/3} when \beta > n^{4/3} log n. Based on joint work with Luca Makowiec and Michele Salvi.

Glauber-Exclusion dynamics: rapid mixing regime

Ryokichi Tanaka
Kyoto University

We show that for any attractive Glauber-Exclusion process on the one-dimensional lattice of size N with periodic boundary condition, if the corresponding hydrodynamic limit equation has a reaction term with a strictly convex potential, then the total-variation mixing time is of order O(log N). In particular, the result covers the full high-temperature regime in the original model introduced by De Masi, Ferrari and Lebowitz (1985). Joint work with Kenkichi Tsunoda (Kyusyu University).

The *-Edge Reinforced random walk, bayesian statistics and statistical physics

Pierre Tarres
NYU Shanghai

We will discuss recent non-reversible generalizations of the Edge-Reinforced Random Walk and its motivation in Bayesian statistics for variable order Markov Chains. The process is partially exchangeable in the sense of Diaconis and Freedman (1982), and its mixing measure can be explicitly computed. It can also be associated with a continuous process called the *-Vertex Reinforced Random Walk, which itself is in general not exchangeable. We will also discuss some properties of that process. Based on joint work with S. Bacallado and C. Sabot.

Covariance Structure of Coulomb System

Tatyana Turova
University of Lund, Sweden

We consider a system of particles on a finite interval with Coulomb 3-dimensional interactions between close neighbours, i.e. only a few other neighbours apart. This model was introduced by Malyshev to study the flow of charged particles. The aim is to describe the distribution of the configuration of particles when their number goes to infinity.

Previously studied case of the nearest-neighbours interactions only offers a rich picture of phase transitions depending on the external force. Here we consider models where the interactions go beyond the nearest-neighbours ones. This leads to qualitatively new features even when the external force is zero. The order of the covariances of distances between pairs of consecutive charges is changed when compared with the former nearest-neighbours case, and moreover the covariances exhibit periodicity in sign: the inter-spacings are positively correlated if the number of inter-spacings between them is odd, otherwise, they are negatively correlated.

In the course of the proof we derive Gaussian approximation for the limit distribution for dependent variables described by a Gibbs distribution, and relate this result to the Central Limit Theorem for dependent random variables.

Periodic homogenization for Levy-type operators

Jian Wang(王健)
Fujian Normal University

The homogenization for Levy-type operators in periodic environments has been studied intensively recently, and all known works are mainly devoted to the qualification results, that is, to determine the explicit form of the limiting operator. In my talk, we establish a quantitative version of homogenization for stable-like operators on with periodic coefficients.This is based on joint works with Xin Chen, Zhen-Qing Chen and Takashi Kumagai.

Hausdorff spectrum for branching random walks on free groups

Longmin Wang(王龙敏)
Nankai University

Consider a supercritical branching random walk taking values on a free group. We compute simultaneously the Hausdorff dimensions of the level sets $E(\alpha, \, \beta)$ of infinite branches in the boundary of the tree (endowed with its standard metric) along which the speed of the BRW have limit points belonging to the given interval $[\alpha, \, \beta]$. Based on joint work with Shuwen Lai (NKU) and Heng Ma (PKU).

Scaling limit of the continuous solid on solid model

Wei Wu(吴炜)
NYU Shanghai

We prove that the Scaling limit of the continuous solid on solid model is a multiple of a Gaussian free field (joint work with Scott Armstrong)

Mixing time for the asymmetric simple exclusion process in a random environment

Shangjie Yang(杨尚杰)
Bar-Ilan University

We consider the simple exclusion process in a finite line segment where the jumping rates of particles are independently sampled from a common law, which is such that a random walk on the whole line is transient. We prove polynomial lower and upper bounds on the mixing time. Joint work with Hubert Lacoin (IMPA)

Gap probability for the hard edge Pearcey process

Lun Zhang(张仑)
Fudan University

The hard edge Pearcey process is universal in random matrix theory and many other stochastic models. In this talk, we consider gap probabilityfor the thinned/unthinned hard edge Pearcey process over the interval (0,s). By working on the relevant Fredholm determinants, we obtain an integral representation of the gap probability via a Hamiltonian related a system of coupled differential equations and the large gap asymptotics. Moreover, we also establish asymptotic statistical properties of the counting function for the hard edge Pearcey process. This talk is based on joint works with Dan Dai, Shuai-Xia Xu and Luming Yao.

SDEs with supercritical distributional drifts

Xicheng Zhang(张希承)
Beijing Institute of Technology

Let $d\geq 2$. In this paper, we investigate the following stochastic differential equation (SDE) in ${\mathbb R}^d$ driven by Brownian motion
$${\rm d} X_t=b(t,X_t){\rm d} t+\sqrt{2}{\rm d} W_t,$$
where b belongs to the space ${\mathbb L}_T^q \mathbf{H}_p^\alpha$ with $\alpha \in [-1, 0]$ and $p,q\in[2, \infty]$, which is a distribution-valued and divergence-free vector field. In the subcritical case $\frac dp+\frac 2q<1+\alpha$, we establish the existence and uniqueness of a weak solution to the integral equation:
$$X_t=X_0+\lim_{n\to\infty}\int^t_0b_n(s,X_s){\rm d} s+\sqrt{2} W_t.$$
Here, $b_n:=b*\phi_n$ represents the mollifying approximation, and the limit is taken in the L^2-sense. In the critical and supercritical case $1+\alpha\leq\frac dp+\frac 2q<2+\alpha$, assuming the initial distribution has an L^2-density, we show the existence of weak solutions and associated Markov processes.Moreover, under the additional assumption that $b=b_1+b_2+{\rm div} a$, where $b_1\in {\mathbb L}^\infty_T{\mathbf B}^{-1}_{\infty,2}$, $b_2\in {\mathbb L}^2_TL^2$, and a is a bounded antisymmetric matrix-valued function, we establish the convergence of mollifying approximation solutions without the need to subtract a subsequence. To illustrate our results, we provide examples of Gaussian random fields and singular interacting particle systems, including the two-dimensional vortex models. (This is a joint work with Zimo Hao).