天元數學國際交流中心
Tianyuan Mathematics Research Center

随机矩阵前沿理论与应用研讨会

Workshop on Frontiers in Random Matrix Theory and Applications

TY-2026-C-072

会议手册

Conference Program

召集人：	**Organizers：**
姚建峰	香港中文大学（深圳）
Benoît Collins	Kyoto University
姚东	江苏师范大学

2026 年 8 月 16 日—22 日

August 16 – 22, 2026

中国 · 昆明

Kunming, China

天元数学国际交流中心简介

天元数学国际交流中心（以下简称“中心”）成立于 2023 年 7 月，由中国科学院、国家自然科学基金委员会、中国数学会、中国科学院数学与系统科学研究院，以及昆明市有关部门共同支持建设的数学与交叉科学交流机构。旨在搭建数学及其跨学科应用领域的学术交流平台，提升我国数学整体研究水平，成为国际一流的数学交流与合作研究中心。

中心位于昆明市宜良县柴石滩水库库区，三面环山、一面临水，环境优美，海拔约 1700 米。距长水国际机场约 90 公里（车程约 1.5 小时），距石林风景区约 30 公里，距九乡风景区约 20 公里。

中心总建筑面积约 6000 平方米，设有大报告厅（可容纳 100 人，配备高清 LED 屏）、中型会议室 1 间、小型会议室 4 间、研讨/工作室 21 间、图书阅览室 1 间、咖啡厅 1 间。专家楼配有 56 间宿舍及自助洗衣房、公共休息区等配套设施。

中心官方网站：http://tianyuan.amss.ac.cn/



Introduction to Tianyuan Mathematics Research Center (TYMRC)

The Tianyuan Mathematics Research Center (established in July 2023) is jointly supported by the Chinese Academy of Sciences, the National Natural Science Foundation of China, the Chinese Mathematical Society, the Academy of Mathematics and Systems Science of the Chinese Academy of Sciences, and relevant departments of Kunming City. It aims to build a platform for academic exchange in mathematics and interdisciplinary applications, enhance China's overall mathematical research level, and become a world-class center for mathematical exchange and collaborative research.

It is located in the national-level public welfare forest in the Chaishitan Reservoir area of Yiliang, Kunming, Yunnan Province, surrounded by mountains on three sides and facing water on one side. The center has a total land area of about 27,000 square meters, with three two-story main buildings, namely the Research Building, the Expert Building and the Logistics Building, which can accommodate nearly 200 people for academic activities, and are equipped with a library and reading room, a restaurant and a certain number of offices and guest rooms.

The center has a total construction area of approximately 6,000 square meters. It features a main lecture hall (capacity: 100 people, equipped with an HD LED screen), one medium-sized seminar room, four small meeting rooms, 21 seminar/workshop rooms, one library and reading room, and one café. The Expert Building is equipped with 56 guest rooms, as well as supporting facilities such as a self-service laundry room and a public lounge.

Official website: http://tianyuan.amss.ac.cn/

会议信息

一、活动日程：

报到：2026 年 8 月 16 日

报告：2026 年 8 月 17 日至 8 月 21 日

离会：2026 年 8 月 22 日

地点：天元数学国际交流中心（云南省昆明市宜良县柴石滩水库）

二、相关事项：

1. 本次研讨会得到天元数学国际交流中心资助，参会人员的住宿及餐饮由中心承担，其余费用（含往返交通费）由参会人员自理。
2. 中心统一安排往返昆明高铁站/长水机场及昆明市区的接送服务。请及时登录项目管理系统（http://tianyuanpm.amss.ac.cn/）登记行程信息。
3. 中心距离医院较远，建议访客适当随时携带一些必备药品。
4. **会议联系人：**

   姚东（江苏师范大学）：15056609386；

   廖振宇（华中科技大学）：13164151928

Conference Information

Ⅰ. Program Schedule:

Check-in: August 16, 2026

Talks: August 16 – August 21, 2026

Departure: August 22, 2026

Venue: Tianyuan Mathematics Research Center (Chishitan Reservoir, Yiliang County, Kunming, Yunnan Province)

Ⅱ. Practical Information:

1. This seminar is financially supported by the TYMRC. Accommodation and meals for participants will be covered by the Center. All other expenses (including round-trip transportation) shall be borne by the participants themselves.
2. The Center will arrange shuttle services to/from the following locations: Kunming High-Speed Railway Station, Kunming Changshui International Airport, and downtown Kunming. Participants are kindly requested to log in to the project management system (http://tianyuanpm.amss.ac.cn/) in a timely manner to register their travel information.
3. As the Center is located at a considerable distance from the nearest hospital, participants are advised to bring an adequate supply of essential personal medications.
4. Conference Contact:

   Dong Yao: 15056609386; Zhenyu Liao: 13164151928

TMRC Workshop on
Frontiers in Random Matrix Theory and Applications (FRMTA)

August 16–22, 2026 @ Tianyuan Mathematics Research Center (TMRC)

General Information

Organizers

- Zhigang Bao, The University of Hong Kong
- Benoît Collins, Kyoto University
- Zhenyu Liao, Huazhong University of Science and Technology
- Dong Yao, Jiangsu Normal University
- Jianfeng Yao, The Chinese University of Hong Kong, Shenzhen

Schedule

- August 16, 2026 (Sunday): Arrival at TMRC
- August 17–21, 2026: Main conference
- August 22, 2026 (Saturday): Departure

Transportation Guide to Tianyuan Mathematical International Exchange Center

A friendly reminder: Tianyuan Center will provide all pick-up and drop-off services. Due to the center's mountainous location, your safety is our priority. To avoid potential risks during inclement weather, we advise planning your arrival for the daytime. Please contact us if you have special requirements.

More Information

For more information about TMRC, please visit http://tianyuan.amss.ac.cn/gr/index.html.

For questions about the conference and assistance, please contact Cathy Chen at cathychen@cuhk.edu.cn.

Zoom link (for online talks only): https://hku.zoom.us/j/91889546635?pwd=beuFzakdRPFznOeErePw18hnJpauO8.1

- Meeting ID: 918 8954 6635
- Password: 077698

Acknowledgements

The conference thanks the RMTA Branch of the Chinese Association of Applied Statistics and Tianyuan Mathematics Research Center for their support.

天元數學國際交流中心
Tianyuan Mathematics Research Center

Program Schedule

Time	Program	Host
Sunday, August 16		
	Workshop Registration	
Monday, August 17		
9:00–9:45	*About the spherical ensemble* (**Djalil Chafaï**, Université Paris Dauphine-PSL)	Xiangdong Li
9:45–10:30	Coffee Break and Discussion	
10:30–11:15	*An equivalence between kernel regression and sequence model* (**Qian Lin**, Tsinghua University)	Qing Yang
11:15–12:00	*Design-based edge-level causal inference with machine learning assisted covariate adjustment* (**Hanzhong Liu**, Tsinghua University)	
12:00–14:30	Lunch	
14:30–15:15	*Infinitesimal Freeness* (**James Mingo**, Queen's University)	Jiyuan Zhang
15:15–16:00	Coffee Break and Discussion	
16:00–16:45	*Geometric bias in eigenspace perturbation under random heterogeneous noise* (**Ke Wang**, Hong Kong University of Science and Technology)	Lun Zhang
16:45–17:30	*Markov Chain Comparisons and Edge Statistics for Inhomogeneous Random Matrices* (**Dangzheng Liu**, University of Science and Technology of China)	
17:30–20:00	Dinner and Discussion	
Tuesday, August 18		
9:00–9:45	*Active Hypothesis Testing under Computational Budgets* (**Yin Xia**, Fudan University)	Lei Shi
9:45–10:30	Coffee Break and Discussion	
10:30–11:15	*Gumbel–Max-Based Acceleration of Attention Matrix Computation in Large Language Models* (**Xiaodong Yan**, Xi'an Jiaotong University)	Bo Zhang
11:15–12:00	*Quantifying Cross-Domain Knowledge Distillation in the Presence of Domain shift* (**Xiao Han**, University of Science and Technology of China)	
12:00–14:30	Lunch	
15:15–16:00	Coffee Break and Discussion	
16:00–16:45	*Strong limit theorem for largest entry of large-dimensional random tensor* (**Xue Ding**, Jilin University)	Weiming Li
16:45–17:30	*Edgeworth corrections for the spiked eigenvalues of non-Gaussian sample covariance matrices with applications* (**Jiang Hu**, Northeast Normal University)	
17:30–20:00	Dinner and Discussion	
Wednesday, August 19		
9:00–9:45	*Approximation of Haar Matrices by Independent Normals and Their Applications* (**Tiefeng Jiang**, The Chinese University of Hong Kong, Shenzhen)	Dong Wang
9:45–10:30	Coffee Break and Discussion	

Time	Program	Host
10:30–12:00	*Approximation of Haar Matrices by Independent Normals and Their Applications* (**Tiefeng Jiang**, The Chinese University of Hong Kong, Shenzhen)	Dong Wang
12:00–14:30	Lunch	
14:30–17:30	Discussion	
17:30–20:00	Dinner and Discussion	
Thursday, August 20, 2026		
9:00–9:45	*Random multiplicative functions* (**Mo Dick Wong**, University of Hong Kong)	Fan Yang
9:45–10:30	Coffee Break and Discussion	
10:30–11:15	*Planar Orthogonal Polynomials and 2D Coulomb Gases* (**Meng Yang**, Central South University)	Yuanyuan Xu
11:15–12:00	*Spectral estimators in general linear models* (**Hongchang Ji**, Sungkyunkwan University)	
12:00–14:30	Lunch	
14:30–15:15	*Phase transition of Schott's statistic for high-dimensional heavy-tailed data* (**Cheng Wang**, Shanghai Jiao Tong University)	Jiang Hu
15:15–16:00	Coffee Break and Discussion	
16:00–16:45	*Periodic KPZ fixed point with general initial conditions* (**Yuchen Liao**, University of Science and Technology of China)	Dong Yao
16:45–17:30	*Strong Convergence for Multiplicative Brownian Motions on the General Linear Group* (**Marwa Banna**, NYU Abu Dhabi, *Online Talk*)	
17:30–20:00	Dinner and Discussion	
Friday, August 21		
9:00–9:45	*What is heat? (Seven views of the rectangular finite free heat flow)* (**Colin McSwiggen**, Institute of Mathematics, Academia Sinica, *Online Talk*)	Zhigang Bao
9:45–10:30	Coffee Break and Discussion	
10:30–11:15	*Central limit theorem for the linear spectral statistics of sample covariance matrix with random population* (**Yiting Li**, Hunan University)	Ke Wang
11:15–12:00	*Rank deficiency of Bernoulli random matrices for large k* (**Hanchao Wang**, Shandong University, *Online Talk*)	
12:00–14:30	Lunch	
14:30–15:15	*Mesoscopic Dynamics in Complex Networks: A Random Matrix Perspective* (**Zhenggang Wang**, Southeast University)	Jianfeng Yao
15:15–16:00	*Operator Norm Estimates of Lehner-type for GUEs via Concentration of Measure* (**Benoît Collins**, Kyoto University, *Online Talk*)	
16:00–17:30	Discussion	
17:30–20:00	Dinner and Discussion	
Saturday, August 22		
	Departure	

Talk Titles, Abstracts, and Biographies

1. **Djalil Chafaï** (Université Paris Dauphine-PSL)

   Title: About the spherical ensemble

   Abstract: We study the fluctuations of logarithmic Green singularities in the spherical ensemble, viewed as a random discretization of the two-sphere. Smooth observables exhibit the usual Sobolev or Gaussian free field fluctuations, whereas logarithmic singularities live on a larger logarithmic scale and asymptotically decouple in high-dimension, producing an explicit white-noise limit. The result gives precise asymptotics for logarithmic potentials and characteristic polynomials, with constants expressed through chordal geometry on the sphere. The talk is based on http://arxiv.org/abs/2606.00330

   Bio: Djalil Chafaï is a Professor of Mathematics at Université Paris-Dauphine – PSL and a member of CEREMADE. Since 2021, he has also been affiliated with the Department of Mathematics and Applications at École normale supérieure (ENS–PSL), where he has served as Director of Studies. He is an honorary member of the Institut universitaire de France (IUF). Professor Chafaï's research lies at the interface of probability theory, analysis, and mathematical physics, including random matrix theory, free probability, Coulomb gases and other related problems in statistical physics and mathematical biology. An active mentor, he has supervised numerous doctoral students and postdoctoral researchers, many of whom have gone on to successful academic careers.

2. **Qian Lin** (Tsinghua University)

   Title: An equivalence between kernel regression and sequence model

   Abstract: In this talk, we shall discuss a new equivalence between sequence model and kernel regression.

   Bio: Qian Lin is an Associate Professor in the Department of Statistics at Tsinghua University. His research centers on the algorithmic theory of AI, especially the mathematical theory of deep learning.

3. **Hanzhong Liu** (Tsinghua University)

   Title: Design-based edge-level causal inference with machine learning assisted covariate adjustment

   Abstract: We study design-based causal inference for edge-level outcomes in directed networks under dyadic interference. In this setting, outcomes are defined on directed edges and depend on the joint treatment assignments of pairs of units, inducing a complex dependence structure that invalidates standard estimation and inference procedures developed for node-level data. We construct Horvitz–Thompson estimators for a general class of edge-level causal effects and establish their asymptotic normality under mild regularity conditions. To enable valid inference, we develop variance estimators that exploit identifiable components of network dependence, yielding substantially less conservative bounds than classical approaches. To improve efficiency, we incorporate auxiliary covariates through a sample splitting and cross-fitting procedure. A key technical challenge is that standard two-fold sample splitting fails in the presence of edge-level outcomes due to the dependence induced by shared units. To address this issue, we introduce a three-fold sample splitting and cross-fitting scheme that restores the conditional independence required for unbiased estimation. Under a stability condition, the resulting covariate-adjusted estimator is asymptotically normal and accommodates both linear adjustment and flexible machine learning methods. We further introduce a calibration step that guarantees no asymptotic efficiency loss relative to the unadjusted estimator. Simulation studies and a real-data application confirm the theoretical results and demonstrate substantial efficiency gains.

   Bio: Hanzhong Liu is a tenured Associate Professor at the Department of Statistics and Data Science, Tsinghua University. He received his Ph.D. in Statistics from Peking University and conducted postdoctoral research at the University of California, Berkeley. His primary research interests include high-dimensional statistical inference and causal inference. His work has been published in journals such as PNAS, JASA, and Biometrika.

4. **James Mingo** (Queen's University)

   Title: Infinitesimal Freeness

   Abstract: A universal rule for computing mixed moments of independent and unitarily invariant random matrices gives, in the large N limit, the rule for free independence. In the forty years since Voiculescu gave this rule many extensions and generalizations have been found. One extension, found by Belinschi and Shlyakhtenko, is called infinitesimal freeness. This has been shown to model the case where the random matrices have different scales, for example in work on subgraphs of large random graphs and principal minors of large random matrices. There are cases where the Belinschi and Shlyakhtenko model doesn't cover some standard examples, in particular the Gaussian orthogonal ensemble. Guillaume Cébron and I have found the extension of infinitesimal freeness to the case of orthogonal invariance. In addition to covering the orthogonal case, real infinitesimal freeness also turns out to be the model of freeness needed for the subleading term of finite freeness, which has recently been found by Arizmendi, Perales, and Vázquez Becerra. There are also connections to Krein's spectral shift and the Markov-Krein transform.

   Bio: James Mingo is from a background in operator algebras and has been exploring the relation between free independence and random matrices.

5. **Ke Wang** (Hong Kong University of Science and Technology)

   Title: Geometric bias in eigenspace perturbation under random heterogeneous noise

   Abstract: Spectral methods are widely used in high-dimensional statistics, but classical perturbation bounds often miss important effects caused by heterogeneous noise. We consider low-rank signal matrices corrupted by centered random noise with general variance profiles. Even when the noise has mean zero, heterogeneity creates a deterministic geometric bias in empirical eigenvalues and eigenspaces. This bias arises from the coupling between signal eigenspaces and the row variance profile of the noise, and it is not visible in perturbation bounds depending only on operator norms and spectral gaps. We present a non-asymptotic framework that provides sharp eigenvalue and eigenspace perturbation bounds explicitly accounting for this geometric bias. Our theory extends beyond standard spiked models without requiring strong incoherence assumptions. We illustrate these effects through applications to spectral embedding and reconstruction problems.

   Bio: Ke Wang is an Associate Professor in the Department of Mathematics at The Hong Kong University of Science and Technology (HKUST). She received her B.S. in Mathematics from the University of Science and Technology of China and her Ph.D. in Mathematics from Rutgers University under the supervision of Van H. Vu. Following postdoctoral positions at the University of Minnesota and a visiting scholarship at Caltech, she joined HKUST in 2016 as a Research Assistant Professor before her current appointment. Her research interests span probabilistic combinatorics, random structures, and random matrix theory with applications to high-dimensional statistics.

6. **Dangzheng Liu** (University of Science and Technology of China)

   Title: Markov Chain Comparisons and Edge Statistics for Inhomogeneous Random Matrices

   Abstract: For symmetric or Hermitian random matrices with independent entries and arbitrary variance profiles, we propose short-to-long comparison conditions and prove Markov chain comparison theorems for edge statistics of two inhomogeneous random matrices. This leads to a remarkably concise correspondence: One CLT, One Statistics–Every specific Local Central Limit Theorem for the variance-profile Markov chain dictates a corresponding universal pattern of edge statistics. This talk is based on joint work with Guangyi Zou.

   Bio: Dang-Zheng Liu is an Associate Professor at the School of Mathematical Sciences, University of Science and Technology of China. He obtained his PhD in Mathematical Sciences from Peking University in 2010. His research interest lies in random matrix theory.

7. **Yin Xia** (Fudan University)

   Title: Active Hypothesis Testing under Computational Budgets

   Abstract: In large-scale hypothesis testing, computing exact p-values or e-values is often resource-intensive, creating a need for budget-aware inferential methods. We propose a general framework for active hypothesis testing that leverages inexpensive auxiliary statistics to allocate a global computational budget. For each hypothesis, our data-adaptive procedure probabilistically decides whether to compute the exact test statistic or a transformed proxy, guaranteeing a valid p-value or e-value while satisfying the exact budget constraint. Theoretical guarantees are established for our constructions, showing that the procedure achieves optimality for e-values and for p-values under independence, and admissibility for p-values under general dependence. Empirical results from simulations and two real-world applications, including a large-scale genome-wide association study (GWAS) and a clinical prediction task leveraging large language models (LLM), demonstrate that our framework improves statistical efficiency under fixed resource limits.

   Bio: Xia Yin is a Professor and doctoral supervisor in the Department of Statistics and Data Science, School of Management, Fudan University. She earned her Ph.D. from the University of Pennsylvania and previously served as a tenure-track Assistant Professor at the University of North Carolina at Chapel Hill. In 2016, she was selected for the Young Thousand Talents Program. In 2020, she was awarded the Excellent Young Scientists Fund of NSFC. She currently serves on the editorial boards of AOS, JASA and AOAS. Her research interests include high-dimensional statistical inference, federated learning, large-scale multiple testing and their applications. She has published over thirty papers in journals such as JASA, AOS, JRSSB and Biometrika.

8. **Xiaodong Yan** (Xi'an Jiaotong University)

   Title: Gumbel–Max-Based Acceleration of Attention Matrix Computation in Large Language Models

   Abstract: In large language model training and reasoning, the vector-computation bottleneck introduced by Softmax has become a major obstacle to fully realizing the potential of low-bit computation. This project proposes a new statistically grounded method for accelerating attention matrix computation. Rather than following the conventional approach of optimizing matrix multiplication, we redesign the Softmax operator itself. First, building on a Gumbel–Max-based probabilistic approximation, we reformulate the Softmax normalization term as a low-overhead and numerically stable stochastic estimation procedure. Second, we develop an approximation scheme for the exponential function in the numerator that is tailored to low-precision hardware such as FP8, with approximation errors designed to cancel systematically. To translate these algorithmic advantages into practical performance gains, we will develop a unified kernel that tightly integrates computation and memory access, enabling fully streaming execution of the attention mechanism and eliminating the memory-access overhead associated with intermediate results. The project aims to achieve a more-than-threefold reduction in the complexity of both matrix and vector computations while maintaining a cosine similarity above 0.999, thereby delivering genuine and balanced end-to-end acceleration.

   Bio: Xiaodong Yan is a Professor at Xi'an Jiaotong University. He is a recipient of the National Young Talent Program and the university's Category-A Young Top-Notch Talent Support Plan. His research focuses on statistical learning for Agentic AI. He has been awarded the "Huawei Spark Priz" and the "DiDi Gaia Scholar" distinction. His academic work has been published in prestigious general science journals including PNAS, leading statistics and economics journals such as JRSSB, AOS, JASA, and JOE, as well as top artificial intelligence conferences including NeurIPS, ICML, and AAAI. He has authored five textbooks published by Higher Education Press and others.

9. **Xiao Han** (University of Science and Technology of China)

   Title: Quantifying Cross-Domain Knowledge Distillation in the Presence of Domain Shift

Abstract: Cross-domain knowledge distillation often suffers from domain shift. Although domain adaptation methods have shown strong empirical success in addressing this issue, their theoretical foundations remain underdeveloped. In this paper, we study knowledge distillation in a teacher–student framework for regularized linear regression and derive high-dimensional asymptotic excess risk for the student estimator, accounting for both covariate shift and model shift. This asymptotic analysis enables a precise characterization of the performance gain in cross-domain knowledge distillation. Our results demonstrate that, even under substantial shifts between the source and target domains, it remains feasible to identify an imitation parameter for which the student model outperforms the student-only baseline. Moreover, we show that the student's generalization performance exhibits the double descent phenomenon.

Bio: Han Xiao is a Professor at the School of Management, University of Science and Technology of China. His research focuses on high-dimensional random matrix theory and high-dimensional statistical inference. His work has been published in the journals and conferences including JASA, AOS, JRSSB, JMLR, Bernoulli, Statistica Sinica, and ICML.

10. **Xue Ding** (Jilin University)

Title: Strong limit theorem for largest entry of large-dimensional random tensor

Abstract: Suppose that $y_\alpha(i)$, $\alpha = 1, \ldots, m$, $i = 1, \ldots, k$, are i.i.d. copies of the random vector $y = (y_1, \ldots, y_p)^\top$. Let $Y_\alpha = y_\alpha(1) \otimes \cdots \otimes y_\alpha(k)$ and consider the random tensor product constructed from the Y_α's. In this talk, we obtain strong limit theorems for the largest entry of a large-dimensional random tensor product under two high-dimensional settings: the polynomial-rate setting and the exponential-rate setting. The conclusions are established under weaker moment conditions than in existing papers, and the relationship between m and p is more flexible.

Bio: Xue Ding is a professor at the School of Mathematics, Jilin University. She received her B.S degree, master's degree, Ph.D. from Jilin University. Since then she has been working at this university. During this period, she also conducted postdoctoral research at Northeast Normal University. Her main research interests include high-dimensional random matrices and their applications.

11. **Jiang Hu** (Northeast Normal University)

Title: Edgeworth corrections for the spiked eigenvalues of non-Gaussian sample covariance matrices with applications

Abstract: Yang and Johnstone (2018) established an Edgeworth correction for the largest sample eigenvalue in a spiked covariance model under the assumption of Gaussian observations, leaving the extension to non-Gaussian settings as an open problem. In this paper, we address this issue by establishing first-order Edgeworth expansions for spiked eigenvalues in both single-spike and multi-spike scenarios with non-Gaussian data. Leveraging these expansions, we construct more accurate confidence intervals for the population spiked eigenvalues and propose a novel estimator for the number of spikes. Simulation studies demonstrate that our proposed methodology outperforms existing approaches in both robustness and accuracy across a wide range of settings, particularly in low-dimensional cases.

Bio: Jiang Hu is a Professor at Northeast Normal University, where he earned his doctorate in 2012. His research primarily focuses on high-dimensional random matrix theory and statistical analysis.

12. **Tiefeng Jiang** (The Chinese University of Hong Kong, Shenzhen)

Title: Approximation of Haar Matrices by Independent Normals and Their Applications

Abstract: We study Haar orthogonal, unitary, and symplectic matrices and their entrywise approximation by independent real, complex, and symplectic Gaussian random variables, respectively. The quality of approximation is quantified in terms of total variation distance, Euclidean distance, supremum norm, Kullback–Leibler divergence, and Hellinger distance.

As an application, we derive limiting empirical distributions for the eigenvalues of Jacobi matrices. We further describe Haar orthogonal, unitary, and symplectic matrices as eigenmatrices of certain typical random matrix ensembles. Finally, we apply the developed approximation framework to problems arising in quantum computing and Yang–Mills theory.

Bio: Tiefeng Jiang is a tenured professor at the School of Data Science, The Chinese University of Hong Kong (Shenzhen), where he has been serving since 2024. He was previously a tenured professor in the Department of Statistics at the University of Minnesota from 1999 to 2024. He received his Ph.D. from Stanford University and was awarded the NSF CAREER Award. His research focuses on probability theory, high-dimensional statistics, and their connections to pure mathematics and interdisciplinary applications. He is well known for his work on Haar random matrices and their approximation by independent Gaussian variables, with applications in quantum computing.

13. **Mo Dick Wong** (University of Hong Kong)

Title: Random multiplicative functions

Abstract: In this talk, I will discuss the asymptotic behaviour of a random walk associated with a Steinhaus multiplicative function. I will begin by explaining the motivation from harmonic analysis and analytic number theory, as well as the connections with the study of characteristic polynomials of circular ensembles. I will then present a central limit theorem exhibiting non-standard scaling and a random variance, closely related to the statistical properties of the Riemann zeta function on the critical line. This is based on joint work with Ofir Gorodetsky.

Bio: Mo Dick Wong is an assistant professor in mathematics at the University of Hong Kong. His research lies in probability theory and its interactions with analysis and geometry. His current work centres on multiplicative chaos, a class of random multifractal measures with applications in random matrix theory, probabilistic number theory, and statistical physics.

14. **Meng Yang** (Central South University)

Title: Planar Orthogonal Polynomials and 2D Coulomb Gases

Abstract: Planar orthogonal polynomials play an important role in studying the statistical behavior of 2D Coulomb Gases. In this talk, I will present the strong asymptotics of planar orthogonal polynomials for the Gaussian weight with logarithmic singularities, and then describe the recent progress in computing correlation kernels and partition functions of 2D Coulomb Gases. This talk is based on recent works with Seung-Yeop Lee, Torben Kruger, Sung-Soo Byun, and Seong-Mi Seo.

Bio: Meng Yang is a Professor at the School of Mathematics and Statistics, Central South University. He earned his Ph.D. from the University of South Florida, USA, and conducted postdoctoral research at the Université catholique de Louvain in Belgium and the University of Copenhagen in Denmark. His main research areas include mathematical physics, random matrix theory, and Coulomb gas models.

15. **Hongchang Ji** (Sungkyunkwan University)

Title: Spectral estimators in general linear models

Abstract: General linear model (GLM) concerns the statistical problem of estimating a vector x from the vector of measurements $y = Ax + e$, where A is a given design matrix whose rows correspond to individual measurements and e represents errors in measurements. In this talk, we consider GLM with the law of A invariant under right-rotation. We present a spectral estimator for this model, that is, the principal eigenvector of a matrix constructed from A and y achieving positive overlap with x, i.e., 'weakly' recovering x. We also present the performance guarantee of our estimator in terms of a lower bound for the sample complexity, that is, the number of samples divided by the number of parameters. Our lower bound for the sample complexity matches with the conjectured (obtained by the replica method) threshold

in Zdeborová et al, 2020 below which any polynomial-time algorithm cannot recover x. If time permits, we will also discuss a recent random matrix ensemble, pseudo-Hermitian matrices, that arises in the same context.

Bio: Hongchang Ji is an assistant professor at Sungkyunkwan University. He obtained his Ph.D. in math from KAIST (2016-2021) and conducted postdoc research at ISTA (2021-2024) and U. Wisconsin Madison (2024-2025).

16. **Cheng Wang** (Shanghai Jiao Tong University)

Title: Phase transition of Schott's statistic for high-dimensional heavy-tailed data

Abstract: Consider Schott's statistic （Schott,2005) defined as the squared Frobenius norm of the sample correlation matrix for data from α-regularly varying populations. We investigate its asymptotic distribution in a general framework characterized by data dimension p, sample size n, and regularly varying coefficients α. In particular, we identify a phase transition phenomenon in the asymptotic behavior. For light-tailed populations ($\alpha > 3$), we revisit the α-free asymptotic distribution but relax the constraint on the ratio of p/n. For heavy-tailed populations ($\alpha < 3$), we derive a new asymptotic normal distribution whose variance explicitly depends on α. We also propose a consistent estimator for the asymptotic variance such that the standardized Schott's test statistic remains applicable for unknown location parameters and all $\alpha > 0$.

Bio: Wang Cheng is a tenured associate professor and doctoral supervisor at the School of Mathematical Sciences, Shanghai Jiao Tong University. He received his Ph.D. from the University of Science and Technology of China in 2013. His main research interests include random matrix theory and its applications, high-dimensional data analysis, and related areas. He has published over thirty academic papers in core statistics journals such as Statistica Sinica and Science China Mathematics. He has led two NSFC projects and two research projects supported by Shanghai Municipality, and has participated in Major Projects of NSFC. He has received honors including the Special Prize of the President of the Chinese Academy of Sciences and the Third Prize for Teaching and Education at Shanghai Jiao Tong University.

17. **Yuchen Liao** (University of Science and Technology of China)

Title: Periodic KPZ fixed point with general initial conditions

Abstract: The KPZ fixed point, first constructed by Matetski, Quastel and Remenik, is a universal scaling limit for a large family of random growth models, known as the Kardar-Parisi-Zhang (KPZ) universality class, in 1+1 dimension. In this talk, I will discuss the analogue of this object on periodic domains, which we call the periodic KPZ fixed point. We derive explicit formulas for the space-time joint distributions of this two-dimensional random field, starting from an arbitrary periodic upper semi-continuous initial condition. It is expected to interpolate the (infinite) KPZ fixed point and the Brownian motion. The formula is obtained by taking scaling limits of formulas of the totally asymmetric simple exclusion process on a ring, under the relaxation time scale $t = O(L^{3/2})$ where L is the size of the ring. The main technical contribution is a new representation of the initial-condition dependence in the multipoint distribution formula for the PTASEP, expressed in terms of hitting times of geometric random walks; this representation is well suited to asymptotic analysis. Based on joint work with Jinho Baik and Zhipeng Liu https://arxiv.org/abs/2603.01964

Bio: Yuchen Liao is a special term professor at the University of Science and Technology of China. Before joining USTC, he held postdoc positions at University of Wisconsin, Madison and University of Warwick. He got his Ph.D. from the University of Michigan under the supervision of Jinho Baik. His primary research interests are in integrable probability and the KPZ universality class.

18. **Marwa Banna** (NYU Abu Dhabi, *Online Talk*)

Title: Strong Convergence for Multiplicative Brownian Motions on the General Linear Group

Abstract: Random matrices provide a natural and fundamental bridge to free probability: in the large-N limit, many independent matrix ensembles converge to free noncommutative random variables. Beyond limiting spectral distributions, recent advances in strong convergence methods have made it possible to control operator norms and spectral behavior in increasingly general settings.

In this talk, I will discuss a strong convergence result for a family of multiplicative Brownian motions on the general linear group. We prove that, as $N \to \infty$, these processes converge to free multiplicative Brownian motion, in the strong sense of almost sure convergence of $*$-moments and operator norms. The talk will outline the motivation from random matrices and free probability, the role of multiplicative Brownian motions, and the main ideas behind the proof.

Bio: Marwa Banna is a mathematician working on high-dimensional probability theory. Her research lies, particularly in free probability theory, random matrix theory, and matrix concentration inequalities. She obtained her PhD from Université Paris-Est Marne-la-Vallée in September 2015. She was then a CNRS postdoctoral associate at Télécom ParisTech before joining the free probability group at Saarland University as a postdoctoral researcher. She is now an Assistant Professor in Mathematics at New York University Abu Dhabi.

19. Colin McSwiggen (Institute of Mathematics, Academia Sinica, *Online Talk*)

Title: What is heat? (Seven views of the rectangular finite free heat flow)

Abstract: The heat equation plays a fundamental role in probability theory through its close connection with diffusion processes. The classical heat flow is described by the convolution of an initial distribution with a Gaussian of increasing variance. Recent decades have seen the emergence of generalized probability theories, such as free probability, rectangular free probability, and finite free probability, in which different objects play the role of the convolution and the Gaussian distribution. Accordingly, each such theory gives rise to its own notion of "heat flow." This talk will explore the similarities and differences between these various conceptions of "heat" via a detailed study of the heat flow that appears in the setting of rectangular finite free probability. As time allows, I will give up to seven different constructions of this process, illustrating the wide range of ways to think about what the heat flow is and where it comes from.

Bio: Colin McSwiggen is an Assistant Research Fellow at the Institute of Mathematics, Academia Sinica. He is broadly interested in the interplay of randomness and symmetry and tends to work on problems related to random matrices, special functions, and/or algebraic combinatorics, but he also enjoys collaborating on unfamiliar topics.

20. Yiting Li (Hunan University)

Title: Central limit theorem for the linear spectral statistics of sample covariance matrix with random population

Abstract: Consider the sample covariance matrix $\Sigma^{1/2}XX^*\Sigma^{1/2}$ where X is an M by N random matrix with independent entries and Σ is an M by M positive definite diagonal matrix. Use $L(f)$ to denote the linear spectral statistics of the sample covariance matrix with test function f. It is known that if Σ is deterministic, then the fluctuation of $L(f)$ converges in distribution to a Gaussian distribution. We prove that if Σ is random and is independent of X, then $L(f)$ multiplied by $N^{-1/2}$ converges in distribution to a Gaussian distribution. This phenomenon implies that the randomness of Σ weakens the correlation among the eigenvalues of the sample covariance matrix. This is a joint work with Ji Oon Lee.

Bio: I got my PhD at Brandeis University under the supervision of Mark Adler. Then I was a postdoc at KTH, CNRS, and KAIST. I joined the faculty of Hunan University in 2023.

21. Hanchao Wang (Shandong University, *Online Talk*)

Title: Rank deficiency of Bernoulli random matrices for large k

Abstract: Let A be an $n \times n$ Bernoulli random matrix whose entries are i.i.d. Bernoulli(p) random variables. We determine the probability that the corank of A is at least k when k is of order $O(\sqrt{\log n})$: $\mathbb{P}(\text{corank}A \geq k) = (1 - p + o_n(1))^{kn}$.

Bio: Wang Hanchao is a professor at Shandong University. He is mainly engaged in teaching and research in probability theory and its applications, with recent research interests including combinatorial random matrices.

22. **Zhenggang Wang** (Southeast University)

Title: Mesoscopic Dynamics in Complex Networks: A Random Matrix Perspective

Abstract: The analysis of complex systems across scales reveals a persistent challenge: the intermediate regime between microscopic fluctuations and macroscopic order resists straightforward characterization.

Bio: Zhenggang Wang is an Assistant Professor at Southeast University (January 1, 2025 – present). He received his B.Sc. in 2016 from the School of Mathematical Sciences, Peking University, and his Ph.D. in 2021 from the Department of Statistics and Actuarial Science, The University of Hong Kong. He subsequently carried out post-doctoral research at The University of Hong Kong (2021 – 2022), the University of California, Davis (2022 – 2024), and City University of Hong Kong (2024). His primary research interests include random matrices, complex networks, random tensors, and high-dimensional statistics.

23. **Benoît Collins** (Kyoto University, *Online Talk*)

Title: Operator Norm Estimates of Lehner-type for GUEs via Concentration of Measure

Abstract: Let $A_0, A_1, \ldots, A_n$ be deterministic Hermitian matrices of fixed size, and let $G_1, \ldots, G_n$ be independent $M \times M$ GUE matrices. Consider the matrix-valued Gaussian sum

$$H_M = A_0 \otimes I_M + \frac{1}{\sqrt{M}} \sum_{i=1}^{n} A_i \otimes G_i.$$

Such models appear throughout free probability, operator algebras, and quantum information, and a basic question is to locate the edges of their spectrum. A classical answer is Lehner's formula, which describes the edge as the solution of an explicit variational problem.

I will explain how the Sudakov–Fernique comparison inequality, suitably extended to matrix coefficients, yields upper bounds of Lehner type for the expected largest and smallest eigenvalues of H_M. The argument is short and relies only on Gaussian comparison, with no moment computations or combinatorics. I will discuss what the method gives, where it is sharp, and a few open questions.

Joint work with Yuta Yamagishi. Preprint: arXiv:2606.21137.

Bio: Benoît Collins is a Professor in the Department of Mathematics at Kyoto University, Japan. He received his PhD from Université Pierre et Marie Curie (Paris 6) in 2003, following studies at the École Normale Supérieure (Paris). Before joining Kyoto University in 2014, he held permanent positions at CNRS (Université Lyon 1) and the University of Ottawa. His research spans random matrix theory, free probability, operator algebras, and quantum information theory. He was an invited speaker at the International Congress of Mathematicians (ICM 2022). He is the recipient of the JSPS Prize (2022), the Autumn Prize of the Mathematical Society of Japan (2023), the Frontiers of Science Award of the International Congress of Basic Science (ICBS, Beijing, 2025), and the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology of Japan (MEXT, 2025).